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Factors Affecting the Life of a Tank

A Contribution to the Discussion of Tank Block Corrosion and Tank Insulation

By F. C. Flint*

That the glassmaker is worried about the decreased length of life of his tanks is putting it mildly. While the customary problems of quality and finish in the glass house have remained the same, the last few years have presented a new problem, namely, the shortened life of the tanks to such an extent that the matter of production loss has become really serious.

In looking for the cause of the difficulty most conscientious investigators in the glass field have looked to their own shortcomings as well as those of the blocks. Putting down all the factors possible, we derive the following list:

1. Quality of the blocks.
2. The cooling system.
3. The care in heating up.
4. The temperature of operation.
5. The quantity of glass melted.
6. Design of the tank.

Taking up the factors as they are listed: The average glass manufacturer has no way of testing the quality of the blocks beyond an ordinary examination which will tell him whether or not they are fairly definitely burned according to present standards and whether they have large holes or cracks in them. Most glass men feel that probably the blocks are at least as good now as they have been in the past. The block manufacturer is probably supervising his operation a little better than formerly, so that the occasional very bad tank does not come to the glassmaker as often as it formerly did. But nevertheless all tanks have a shorter life and some are extremely short.

So far as the quality of the clay is concerned, and changes in composition, the ceramist's particular field, the glass man knows little or nothing of this and has to take what is presented to him with a good deal of faith and await results.

The cooling system on the tank is customarily a wind and water system. These vary all the way from the finished application of high velocity wind to mere excuses of piping systems with not much more wind than the natural convection currents around the hot tank. Apropos of insulation, this has not been tried because heretofore it has been felt that the more cooling applied to the block, the better it held. When occasionally a block is placed back of one which is nearly through, thus more or less effectively insulating it, corrosion has been greater. This has been tried a number of times by a good many glass manufacturers. I do realize that half way insulation or half way cooling may not tell the story. It will be necessary to make a complete job of it and actually insulate sufficiently all portions of the tank to prevent currents being set up, but no glass man whose factory production depends on such a large single unit as a tank, is going to jeopardize his production with such an experiment until it has been tried out adequately and a number of times by smaller units.

Water cooling, so far as helping the blocks is concerned, seldom does any good. The block corrodes faster until it gets so thin that the water back is holding the glass. This is satisfactory as long as water is flowing through, but it is not answering the problem of tank block corrosion.

As to the matter of heating, block men themselves are not uniform in what they demand in heating up a tank, schedules ranging all the way from ten days to three weeks. On the whole, glass men, because of the difficulties they are having, are much more careful than they ever have been before. The average heating up schedule of tanks is approximately two weeks. This seems to have no bearing on the shortened life of tanks.

Regarding temperature of operation and production of glass, these two seem to go along together. The glass man will admit that he is now pulling more glass than he formerly did. Refinements in operation have put greater demands on the tank. The tanks have been enlarged but very often not sufficiently to take care of the increased pull without laying a heavier burden on the tank. To facilitate this the temperatures have been raised because now, more than ever, the glass quality must be at its best at all times.

But a comparison of the increased tonnage in no way approaches the decreased tank life. When actual figures are compared and tonnages taken from the tanks now and

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in former years, the increased pull is insignificant compared with the shortened tank life. Comparing the tank on the basis of the glass pulled out, not as much glass is passed through the furnace in its total life as formerly went through.

In other words we have now reached a point where we no longer get a benefit from further temperature or production increases because losses due to tank repairs more than balance the benefits of more tonnage.

On the whole, tanks are operated approximately at 2,600 deg. F. Very many are operated at from 50 to 75 deg. in excess of this. Formerly they were not operated at such a heat, 2,500 deg. F. or less being the habit. Glass is produced at about 11 sq. ft. or less per ton per day and many tanks produce more than this. The batches have not varied greatly.

The most effective way to help the situation is not by working on the outside of the tank but either:

1. Change the conditions on the inside of the furnace, or

2. Change the block and its resistance to those conditions.

To change the conditions inside the tanks would mean lowering of the temperature and melting less glass per unit. The temperature would gladly be lowered due to its cost, but production can not gracefully be cut down, particularly when every other department of the factory is capable of doing even more than it is now.

Any change in the block must be made when the block is manufactured. Some efforts have been made to make the block more dense. Insofar as it does not affect the refractory quality of the blocks, it should be a benefit. It presents less pore space to the glass attack. Penetration should be more difficult.

The composition of the block affects most of its other properties. One particularly, the solubility of the constituents in glass is very important. That no great progress has been made along this line is probably due to the fact that very few men have considered extensive efforts on anything but the customary ingredients and proportions; and all these must fit the present mode of manufacture. The best that can be expected from these efforts is one or two more months' life for the tank. Refractiveness of the block and its temperature of burn are two closely bound subjects that have not yet been cleared up.

If the tank is heated to 2,600 deg. the inside of the block approaches this heat and it does not look unreasonable to ask that the block be prepared for this by being burned at 2,600 deg. or more.

This offers added difficulties to the block manufacturer, by increased fuel expense, higher losses in manufacture and inability of the blocks to stand up any length of time under the heat and with the load of superimposed blocks on them.

The fuel bill is an economic consideration that must be tried to prove it. Maybe the direct coal fired kiln can be improved upon and kiln losses are better taken in the long run at the kiln door than in the glass tanks.

The fact that the block is indented at 2,700 deg. F. with the blocks placed above it makes its chance for survival rather poor in a 2,600 deg. F. tank. This must not be mixed with kiln marks due to water smoking trouble. That the block softens implies that it is approaching a fluid condition itself and as such is not capable of withstanding the attack of the molten glass as well as if it were still solid, chemical reactions do not proceed very rapidly in the solid state. As long as the solid block can resist percolation of the glass into its interior it is capable of withstanding a fair amount of corrosion. But when the temperature at which it is used is such that it is almost a liquid itself, becomes pasty, it does not take much for the glass to attack it and form a glass. From then on it does not make so much difference what the mechanism of removal is, the block itself is gone.

As the block is being heated so near its eutectic, the only advantage insulation can have would be in permitting a lower tank temperature that the block would not need to be heated as high, say 2,500 deg. F. instead of 2,600 deg. F. A number of calculations of heat losses on the tank indicate that the side blocks of the tank do not radiate more than 10% of the total heat put into the tank. This is not sufficient to assist in lowering the temperature of the tank enough to help very much, about 25 deg. F. for perfect insulation. To effect a fuel saving the port necks and off-takes and the crown should be covered. These release nearly half the heat used. But insulating them does not relieve the flux blocks and other complications are introduced.

On the other hand greater depth of heat in the glass by insulation may be an assistance to the glass man in increasing his production of good glass even more than he is now doing, still keeping up the same old temperature and burning up his tanks in the same old way.

Further Discussion

Of the Tank Block Problem

Much interest has been aroused in the proposal of W. K. Brownlee of the Buckeye Clay Pot Company, that glass manufacturers lessen the corrosion of tank blocks and conserve fuel by insulating their melting tanks. Few experiments have been made along this line and wide differences of opinion exist throughout the industry regarding the probable effect of insulation on the blocks.

For the purpose of throwing as much light as possible on the problem and thereby perhaps aiding in its ultimate solution, some views and comments on articles recently published in THE GLASS INDUSTRY are given below. The commentators include a well known manufacturer of refractories, a tank and furnace engineer, an insulating engineer, and a glass chemist.

Has Met Situation Successfully

To the Editor of THE GLASS INDUSTRY:

We have your favor of the 19th inst. wherein you submit proofs of "Some Aspects of Tank Block Corrosion,"[1] by Dr. S. R. Scholes of the Federal Glass Co., Columbus, Ohio, commenting on the paper by Mr. Wm. K. Brownlee concerning glass tank insulation in your journal of July, 1924.

The writer has reviewed Mr. Brownlee's paper, likewise read with much interest the article written by Dr. Scholes. Our decision is that we are inclined to favor the latter's opinion very highly on this subject.

Prior to the war the average glass manufacturer did not have serious complaints to offer to the tank block manufacturer that his blocks did not give reasonable service. Of course there will always be complaints as long as clay is used for a heat and flux resistant, as so many people imagine that clay cannot be melted or destroyed. But to our way of thinking, that piece of clay has never been dis-

[1] THIS JOURNAL, September, 1924, page 161.

covered or produced which cannot be destroyed by heat or fluxes providing there is enough of each applied.

During the war the average glass manufacturer could not meet the demands of his customers for his ware and he looked about for a more rapid method of melting and something to get larger production. In this he was assisted largely by using different decolorizers than formerly, such as selenium and others, and he got larger production by applying more heat and putting in improved machinery. He got what he was looking for but discovered "there is never a joy without alloy" for it was at the expense of the tank block.

During all the years of the war the glass manufacturer put up a howl that his blocks were not standing up as they did prior to that time when they were able to get German clays. Now, since German clays have become available he fails to find the relief he looked for. He had tried out every make of tank block to be found and the results were practically the same. Never for a moment did he think to check up the changes made in his batches, the temperatures at which he was operating his tank, or the method of operation. All the tank block manufacturer got was condemnation.

During the war we tested out no less than 75 samples of clay, employed a first-class ceramic engineer, built a new laboratory, and waded into the question very carefully. In conference with out competitors they decided possibly it would be a good plan for a number of us to go together and go into this matter in order to get the very best available in this country. The result was we all fully decided that a clay found at Witcliffe, Ky., was the best clay offered. As a result, this mine was purchased and operated by some of the leading tank block manufacturers of this country with fairly good results.

But the moment German clays became accessible these various tank block manufacturers dropped the use of Witcliffe clay and went back to the German clays. As a result of this the mine has been closed and abandoned.

It was not because German clays were used in his blocks and did not bring forth the results expected that the glass manufacturer had trouble, but it was due to the fact that he was operating at higher temperatures and consequently working and melting more batch—all of which affected his blocks. But the glass manufacturer was blind to the possibility that anything he had brought about caused the disintegration of the tank block.

However, one glass manufacturer who gave the matter considerable thought and had gone into the question closely discovered he was producing considerably more ware from his tank and clearing up his glass in about half the time he formerly did. He decided he could not afford to go backwards, that he must have rapid production as well as rapid clearing up of glass; and concluded that the tank block manufacturer must awaken to the fact that he must meet the situation with a block that would withstand all these abuses.

He called upon us to produce a better block than we had ever produced before, that would withstand his requirements. After spending almost 14 months working in our laboratory we finally perfected a block that met the demands of this particular manufacturer.

If the glass industry is to continue its increased production and other changes and finds it absolutely necessary to have these, then the tank block manufacturer must meet these conditions by producing a block that will withstand these demands. We have satisfied ourselves beyond a reasonable doubt that this situation can be met for we have demonstrated it not only to ourselves but to our customer as well that *it can be done* for we have produced a block that will withstand the corrosion that is causing all these troubles.

AUGUST 27, 1924. A REFRACTORY MANUFACTURER.

Tank Block Troubles:

"Due to deficient blocks"— ***says the glass manufacturer.***

"Caused by abuse of blocks," ***replies the block maker.***

Who knows?

Why not combine efforts and find out?

From a Tank and Furnace Engineer

To the Editor of THE GLASS INDUSTRY:

We have your letter of August 18th with advance galley proof of Dr. Scholes' article covering Tank Block Corrosion and we certainly agree with you that this article is very interesting indeed.

While some of the trouble may be due to an inferior quality of tank blocks, we are inclined to believe that the bulk of the trouble is due to the fact that the tanks are being pulled harder than they used to be, which necessarily involves higher temperatures; in fact we have known furnaces to go out in eleven weeks and the same furnace when relined with the same company's materials, which would analyze identically with the materials that were used previously, lasted ten to fourteen months and the records show the tonnage pulled from them each and every day practically the same. This would clearly indicate that the trouble was not tank blocks but the way the furnace was operated.

We know of tanks that were formerly worked by hand on a basis of two 9¼ hour shifts, which were later equipped with feeders and semi-automatic machines. The tonnage taken from the tanks was doubled. This increased tonnage automatically decreased the life of these tanks from 30 to 50 per cent until after a method of cooling the tanks was resorted to. After being properly cooled the life of the tanks was greater with the increased tonnage than it was prior to the installation of the feeders.

We are inclined to disagree with Dr. Scholes on the subject of wearing of throats because we believe that the wear of these throats is proportional to the velocity of the glass through them and we have pretty clearly demonstrated that this is a fact by building tanks with more than one throat; in fact we have built tanks with two and three throats which showed conclusively that the wear on them was proportional to the flow of glass through them.

We believe that the secret of long life tank blocks is more moderate tonnages, moderate use of fluxes, which based on other terms is not to rate the tanks so high, or in other words, increase the melting area per ton of glass required.

AUGUST 19, 1924. ENGINEER.

From an Insulating Engineer

To the Editor of THE GLASS INDUSTRY:

It is apparent from the varying theories advanced for the cause of the short life of tank blocks, that very little of a definite nature is known on this subject. Dr. Scholes' theory on this subject sounds very logical. We are of the opinion after reading his article that failure of the tank blocks is probably due to a combination of corrosion and erosion. It would seem, however, from the test which Mr. Brownlee ran where the insulated tank walls were free of lines of vertical erosion after a 30 day run, that erosion due to convection currents was of the more importance.

Mr. Brownlee has stated in his paper that the use of insulation will not mean that a higher working temperature will result, but rather that due to the reduction of radiation losses, the working area can be maintained with a lower temperature in the upper level of the molten glass. In other words, the mean temperature would be increased without an increase in the maximum temperature.

As Dr. Scholes states, much can be said on both sides of the question. The only way the effect of insulation can be definitely determined is by the insulation of a plant scale furnace and careful observance of results secured. We believe the possibilities for insulation are sufficiently great to warrant the larger companies giving it a plant scale trial. If found to be successful, the fuel savings alone would amount to a great deal. Of course if insulation should cause a material shortening in the life of the tank blocks, this fuel saving would not be sound economy.

CHICAGO, ILL. CELITE PRODUCTS CO.,
AUGUST 23, 1924. Edw. A. Phoenix.

To the Editor of THE GLASS INDUSTRY:

Since our previous letter to you on this subject, we have re-read Dr. Scholes' article and have given it a little more thought than we were able to previously. It is Dr. Scholes' theory that corrosion of the tank block increases the specific gravity of the molten

glass next to the blocks, causing a downward movement resulting in vertical erosion. It would seem to us, however, that this condition would obtain only in a very thin film of glass next to the blocks and that this would not be sufficient to cause any appreciable tendency to settle and set up internal circulation of the glass. We have endeavored to consider this from an entirely unbiased viewpoint but Mr. Brownlee's theory of convection currents sounds much more logical to us.

CHICAGO, ILL. CELITE PRODUCTS COMPANY,
SEPTEMBER 20, 1924. Edw. A. Phoenix.

From the Author of "Some Aspects of Tank Block Corrosion"

To the Editor of THE GLASS INDUSTRY:

Referring to Mr. Phoenix's letter of August 23, it is true that hardly enough definite knowledge is at hand to permit the formulation of a complete theory of tank block corrosion. At present, however, it seems consistent with the facts to think of this corrosion as the result of the lowering of the melting point of the block material because of contact with the glass, whereby slow fusion takes place, and the block substance becomes incorporated with the glass.

A pre-requisite to a discussion of the relative importance of corrosion and erosion is a set of precise definitions of these terms. Perhaps we would agree that corrosion is solvent action independent of movement of the solvent, while erosion is rather a wearing effect depending primarily on movement. But corrosion is more rapid when the solvent is stirred, and erosion proceeds more rapidly when the eroding agent carries a solvent with it. Examples may be found in discussions of the wearing away of the rocks through geological ages. Geologists emphasize the importance of sand and other abrasives carried by the wind or water in the erosion of rocks.

Now glass seldom carries abrasives, and we must think of it as a liquid which would move over a clay surface almost without friction. But if we think of the effect of movement of the solvent glass, carrying away the dissolved or partially melted (fluxed) clay, exposing a fresh surface for attack, we will all agree that the rate of attack is increased.

It is idle to expect enthusiasm over longer-lived tank blocks from those whose business is rebuilding tanks. And it is just as idle for them to propose that glass manufacturers be content with lower tonnages. That would be retrogression. The glass factory must keep up its speed of production per unit of fuel and labor expended, and it is up to the block factory to supply blocks that will permit of modern tonnages without the present high mortality among tanks. We cannot admit that the best material for tank blocks has yet been developed.

COLUMBUS, OHIO.
SEPTEMBER 22, 1924. S. R. SCHOLES.

Boric Oxide In Glass*

By adding boric oxide to a sodium-silicate batch the coefficient of expansion of the glass produced is first of all reduced, ultimately reaches a minimum, and then increases. With glasses containing 20 per cent Na_2O the minimum thermal expansion occurred with approximately 17 per cent boric oxide: glasses analyzing 10 per cent Na_2O reached the minimum with 20 per cent B_2O_3.

Low coefficient of expansion is an essential feature of glass required to withstand rapid changes of temperature, and physical shocks. It has been shown that B_2O_3 reduces the coefficient of expansion—in addition, it increases elasticity: the tests demonstrate that boro-silicates have a greater degree of thermal endurance, and tolerate more severe physical shock than other glasses. The presence of boric oxide also provides resistance to the action of steam, and cold and hot water.

Glasses rich in B_2O_3 are not the most resistant to either strong or dilute caustic soda solutions. The U.S.A. Bureau of Standards report asserts that "alkalis cannot be safely evaporated in any glass of which we have knowledge." This opinion is supported by the "findings" of other investigators. The best glasses for this purpose were those containing approximately 5 per cent. B_2O_3: the glasses free from this oxide registered the most severe losses.

The glasses with generous B_2O_3 content were least affected by the action of ammonium sulphide, ammonium chloride, ammonia, potassium carbonate, sodium carbonate, and sodium phosphate.

The influence of boric oxide upon the acid-resisting properties of glass depends on the relationship of the amount of this to other oxides present, especially silica. Among glasses tested with hydrochloric acid, some rich in B_2O_3 showed considerable loss, while for others (with high B_2O_3 content) the loss was small. It is noteworthy that Pyrex (11.8 per cent B_2O_3 and 80 per cent SiO_2) is but slightly attacked by hydrochloric acid. Sulphuric and nitric acids are without appreciable action on boro-silicate glasses.

The replacement of silica by boric oxide was accompanied by a reduction in the time needed to melt the batch, and the elimination of seed or bubbles was also accelerated.

*From "Boric Oxide as a Constituent of Glass," published by Pacific Coast Borax Co.

The Use of Boric Oxide in Glass for Electric Insulators

Generally speaking, it was found by Kohlrausch that the more durable the glass the better its insulating power. It would follow, therefore, that the boro-silicate glasses, being of the resistant type, should serve as good insulators.

Very few direct measurements of the electrical resistance of glasses have been made. It is of interest to note that the most resistant of the glasses measured by A. Gray and J. J. Dobbie (Proc. Roy. Soc., 1898, *63*, 38; 1900, *67*, 197) was a boro-silicate of percentage composition; barium oxide 48, silica 33, boric oxide 12, and iron oxide and alumina 6. Even at a temperature of 140° the specific resistance of this glass exceeded 59,000 ohms.

A. E. Marshall (J. Ind. Eng. Chem., 1923, *15*, 141) has claimed that Pyrex glass serves admirably for high tension electrical insulators.

Boric Oxide as a Flux

The fluidity of borates when melted is known to be greater than that of silicates, although important viscosity measurements remain yet to be carried out.

This greater fluidity is an important factor in the now well-known use of boric oxide or borax as a flux. There are other substances which by reason of their low melting point or fluidity when melted also serve as fluxes, such as sodium and potassium carbonates and nitrates, and calcium fluoride. Boric oxide has the advantage not only of assisting melting but also, within limits, of improving the stability of glass, while the alkaline carbonates and nitrates impair it.

Methods of Analysis of the Laboratory of the Crystal Glass Works of Val-Saint-Lambert*

By Ad. Lecrenier†

In every laboratory the chemist is forced by the special needs of the industry to which he belongs to examine the raw materials which are used from a particular point of view. For instance, small amounts of iron in potash are entirely without importance to the soap manufacturer, but they attract the immediate attention of the chemist of a crystal glass factory. The result is that in each line it is necessary to apply special methods which are not found in general text books on analytical chemistry.

A description of these methods may be helpful to chemists and it has been thought of interest to outline those which have been used for about fifteen years in the laboratory of the Crystal Glass Works of Val-St.-Lambert.

Sand

Sand is the basis of the manufacture of glass. From a physical standpoint, the fineness of the grain exerts a considerable influence on the speed with which the glass is melted and indirectly on its purity, since glass should remain as short a time as possible in contact with the aluminous material which forms the pots in which the melting takes place. From a chemical point of view the color and polish of the finished product depend upon the purity of the sand, that is to say, upon the more or less complete absence of metallic coloring compounds. The estimation of iron therefore is the most important feature of the analysis of this material. The ordinary method used in the analysis of silicates, namely, the decomposition by alkali-carbonates, taking up with acid, separation of silica and determination of iron on the filtrate is practically impossible and much too long. Numerous experiments have shown that the results of this course have only a relative value and are very irregular, no matter what precautions are taken to prevent the accidental introduction of iron dust. The following procedure is the result of research done to simplify this determination. It is daily applied in this laboratory and has the important advantage of giving very quick results.

Two grams of washed, dried and sifted sand are transferred to a platinum crucible, 7 cm. in diameter and 3 cm. high. Nine grams of pure and dry sodium-potassium carbonate of known iron content are added. After mixing, the cover is put on the crucible and the latter is placed into a small muffle furnace, which is heated to a white heat, where it remains until the complete solution of the sand and quiet fusion of the molten mass. After cooling the whole is detached in a single piece, which is placed in a beaker, 11 cm. high and 8 cm. in diameter. Distilled water is added up to about half of the block. The beaker is covered and complete solution of the mass is allowed to take place. Solution is hastened by shaking the beaker from time to time, but without uncovering to introduce a stirring rod, for in view of the small quantity to be estimated the success of the operation depends on the care which is taken to prevent contamination of the liquid with dust. After complete solution 20 cc. of hydrochloric acid of a density of 1.2 is added. Under these conditions the liquid becomes decidedly acid and the silica remains in solution in the form of orthosilicate. To the liquid is added a spoonful of pure potassium thiocyanate[1] which produces a pink coloration, the intensity of which is proportional to the quantity of iron contained in the sand. To estimate exactly this quantity a beaker of the same size, containing the same amounts of water, hydrochloric acid and thiocyanate is placed next to the beaker containing the pink liquid. From a burette is added, drop by drop, a solution containing .0001 grams of iron as Fe_2Cl_6 per cc. When the two liquids show the same color intensity a simple calculation gives the amount of iron oxide (Fe_2O_3) in the sand. The amount of iron in the highest grades of sand used in the manufacture of crystal glass ranges between .005 and .015 per cent iron oxide. In sand used for goblets the amount may go as high as .040 per cent. The estimation of the other constituents, alumina, lime, magnesia, is done according to the usual methods after elimination of the silica with hydrofluoric acid, density 1.3, diluted with two volumes of water and to which a little sulphuric acid has been added.

The method of direct decomposition of the sand with sodium-potassium carbonate gives results which are much too high in alumina, since it is very difficult to render large quantities of silica insoluble. A part of the latter is usually found with the alumina.

Soda Ash

The material used generally in glassworks is Solvay soda. It has the following average composition:

	Per Cent
Sodium carbonate	99.24
Sodium chloride	0.38
Sodium sulphate	0.15
Calcium carbonate	0.12
Magnesium carbonate	0.08
Iron oxide	0.015
Water and undetermined	0.035
	100.00

The carbonate is determined by alkalimetric titration with methylorange as indicator. For the estimation of chlorine the gravimetric process is used. The estimation of iron is done colorimetrically as described in the analysis of sand.

Potash

The pure products made by using Stassfurt salts have completely replaced the old forms of potash made from wool

* *Le Verre*, Vol. 4, No. 6 (June, 1924) pp. 125-128. Translated for THE GLASS INDUSTRY.

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[1] Some samples of impure thiocyanate give a pink coloration through the action of pure acids, free from iron and cannot be used (De Koninck, Course of Analytical Chemistry).

scourings, sugar beet residues, etc., which are quite insufficiently pure. Pure potash is found in commerce in the form of calcined potassium carbonate. The following analysis gives an idea of the composition of this material:

1. CALCINED POTASH

	Per Cent
Potassium carbonate	97.10
Sodium carbonate	0.04
Water	2.40
Potassium chloride	0.36
Potassium sulphate	0.04
Iron oxide	0.017
Silica	0.016
Alumina	0.021
Lime	0.006
	100.00

2. HYDRATED POTASH

	Per Cent
Potassium carbonate	83.21
Sodium carbonate	0.04
Potassium chloride	0.28
Potassium sulphate	0.03
Iron oxide	0.0008
Insoluble residue	0.0023
Water	16.44
	100.00

These products are always sold on analysis and the work of the chemist is limited to controlling the accuracy by well known methods. The iron oxide is in this case also determined by the colorimetric thiocyanate method.

Limestone

Lime is introduced in the batch in the form of hydrated lime or limestone. The latter is generally preferred on account of its greater regularity of composition. The following analysis gives the average percentage of the different constituents of limestone used in glass making.

	Per Cent
Calcium carbonate (by difference)	98.9481
Calcium sulphate	0.0246
Calcium phosphate	0.0072
Magnesium carbonate	0.6420
Manganese carbonate	0.0111
Alumina	0.0030
Organic matter	0.0312
Soluble residue (containing 0.0077 Fe_2O_3)	0.1264
Water	0.2000
	100.00
Iron oxide	0.0141

The analysis presents no special difficulties. For the estimation of magnesium carbonate the sample for analysis is 5 grams. For the other constituents it is 100 grams. The estimation of organic matter and of the insoluble residue is done by collecting the total residue on a tared filter and weighing it after drying. The filter is then burned and the residue is weighed alone. The difference between the two weights gives the organic matter.

Lead

The lead used in crystal glass is a product prepared especially for the industry. It is purified to the utmost limits. The methods of analysis for the estimation of iron and copper are as follows:

1. *Estimation of Iron.* Twenty grams of granulated lead are dissolved in nitric acid in slight excess. The solution is transferred to a 250 cc. standard flask. After adding a sufficient amount of sulphuric acid to precipitate the lead as sulphate, the liquid is diluted to the mark and filtered through a dry filter. Two hundred cc. of the filtrate (representing 16 grams of lead) are pipetted into a dish and are evaporated to dryness. The residue is taken up with one cc. of concentrated hydrochloric acid and a little water. It is then transferred to a beaker, diluted to 500 cc. and a measured volume of potassium thiocyanate is added. In another beaker of the same dimensions the same amounts of hydrochloric acid, water and potassium thiocyanate are added. The two beakers are placed on a white ground; to the one used for comparison a standard solution of ferric chloride is added, containing .0001 grams of iron per cc. until the reddish color (ferric thiocyanate) is of the same intensity in both beakers. From the number of cc. used, the quantity of iron in the sample of lead is then calculated.

2. *Estimation of Copper.* The above procedure is followed, including taking up with hydrochloric acid of the residue obtained by evaporation of 200 cc. The volume is diluted to 10 cc. in a glass tube, ammonia is added until the liquid is alkaline. The blue color of the ammoniacal copper compound which is formed is compared with a series of tubes containing the same quantities of reagents as the sample and with increasing quantities of copper.

Analysis of Glass

Two different courses of analysis can be followed, depending on whether the glass to be analyzed contains lead or not. Which procedure to follow can be easily ascertained by means of a simple blow-pipe test. For lead-free glass the following method is followed:

Two grams of pulverized glass are transferred to a platinum crucible and covered with about 10 cc. of water. 25 cc. of pure hydrofluoric acid, density 1.3 are added. The crucible is heated slightly for a few minutes until the reaction is completed. A few cc. of sulphuric acid, 1.3 are added and the content of the crucible is evaporated to dryness. It is then heated for a few minutes over an open flame until fumes of sulphuric acid appear, to be certain that all hydrofluoric acid has been completely expelled. The residue is digested with water, and acidified with hydrochloric acid until complete solution. In the acid liquid arsenic and antimony are precipitated with hydrogen sulphide. The precipitate of the combined sulphides is digested with aqua regia or with a mixture of hydrochloric acid and powdered potassium chlorate. After the elimination of the excess acid a little tartaric acid is added and the solution neutralized with ammonia. The arsenic is precipitated from the solution by magnesia mixture as ammonium magnesium arsenate and in the filtrate from the latter antimony is precipitated with hydrogen sulphide after removal of the ammonia and acidifying the liquid with hydrochloric acid.

In the filtrate of the arsenic and antimony the metals of the iron group are precipitated with ammonium sulphide. The remaining liquid contains lime, magnesia and the alkalies.

First the lime is precipitated with ammonium oxalate, the filtrate from the calcium oxalate is evaporated to dryness. The residue is calcined until the ammonium salts are de-

composed and the sulphates of magnesia, potash and soda are weighed together. Water is added and the magnesia precipitated with ammonium phosphate. In the filtrate the total sulphuric acid is determined. Knowing the weight of the three sulphates and of the magnesium sulphate (which usually is small) the proportion of the oxides of magnesium, potassium and sodium can be easily calculated.

For glasses containing lead the general course of analysis is the same, but after evaporation to dryness of the sample taken for analysis it is necessary to digest with fairly concentrated hydrochloric acid in order to completely dissolve the lead sulphate formed, so that it can be subsequently precipitated together with arsenic and antimony and separated from these two elements with ammonium sulphide. It is not feasible, as one would believe, to digest the precipitate with dilute sulphuric acid and separate the lead as sulphate, because lead sulphate, when evaporated to dryness with potassium sulphate retains large quantities of the latter which would completely vitiate the results.

Nitrate of Potash

The product used in glass making is that which is manufactured for the production of powder. It is purified to .00002. The analysis of this material is limited to the estimation of sodium chloride which it may contain.

Nitrate of Soda

This material, sold in commerce under the name of Chili saltpetre, is used in glass making either in the raw state or after having been first purified by solution and crystallization. The two following analyses, done according to well known methods give an idea of the composition of these nitrates.

RAW NITRATE OF SODA

		Per Cent	
Water and organic materials		2.325	
Sodium nitrate		87.433	
Potassium nitrate		7.201	
Potassium nitrite		0.012	
Potassium chloride		1.702	
Potassium iodate		0.225	
Calcium carbonate		0.014	
Magnesium sulphate		0.546	
Magnesium carbonate		0.149	
Soluble iron oxide		0.005	
Alumina		0.006	
Insoluble residue	iron oxide	0.0048	0.127
	alumina	0.0172	
	silica	0.015	
Total iron oxide		0.0098	

REFINED NITRATE OF SODA

	Per Cent
Water	1.925
Sodium nitrate	98.824
Potassium nitrate	0.751
Potassium chloride	0.351
Potassium sulphate	0.104
Potassium iodate	0.023
Calcium carbonate	0.001
Iron oxide and alumina	0.003
Insoluble residue	0.008
Total ferric oxide	0.001

Manganese

The analysis is usually limited to the estimation of manganese dioxide by titration, using the iodometric procedure and the determination of iron oxide. The following is a complete analysis which gives the average composition of a material of good quality, used in glass making.

		Per Cent	
Water		1.39	
Manganese dioxide		90.20	
Lead dioxide		0.09	
Nickel oxide		0.03	
Iron oxide		0.68	
Alumina		1.14	
Zinc oxide		0.05	
Calcium carbonate		0.90	
Insoluble residue	silica	4.02	5.52
	alumina	0.20	
	iron oxide	0.04	
	barium sulphate	1.26	
		100.00	
Total iron oxide		0.72	

Hydrofluoric Acid

Hydrofluoric acid is one of the most important accessory products in the manufacture of glass. The composition should be carefully watched. The analysis is done as follows:

Determination of the specific gravity. This is done by means of a rubber container with a narrow opening and with a capacity of 100 cc. It is first weighed empty, then it is weighed full of water and finally filled with the acid to be tested and its weight determined. A sensitive pharmaceutical balance is sufficient for these weighings.

Estimation of sulphuric acid. About ten grams are weighed out in a platinum tube closed with a cork covered with paraffin. The sample is evaporated in a platinum crucible on a water bath. After complete removal of hydrofluoric acid and hydrofluosilicic acid the residue is taken up with water and the sulphuric acid estimated by alkalimetric titration.

Estimation of hydrofluosilicic acid. A preliminary test is made to ascertain the approximate amount of hydrofluosilicic acid in the sample by making a few grams alkaline by addition of ammonium carbonate. Depending on whether the precipitate of silica is more or less abundant, a sample of from 5-25 grams is taken. After removal of the water, the sample—which is contained in a platinum crucible—is neutralized with a solution of caustic potash. Ammoniacal zinc oxide solution is added and a little ammonium carbonate, to change the excess of potash to the carbonate form. The solution is then evaporated until the complete disappearance of the ammonia. The residue is taken up with water. A mixture of silica and zinc oxide is obtained which after washing is treated with hydrochloric acid, sufficient to obtain the silica pure and free from zinc chloride. The weight of the silica after ignition gives by calculation the amount of hydrofluosilicic acid present.

Estimation of hydrofluoric acid. About 5 grams of hydrofluoric acid are weighed and poured into a beaker covered with paraffin, which contains 100 cc. of a standard potassium hydrate solution. This solution should have such a strength that it is nearly neutralized by the sample of hydrofluoric acid. The excess of potassium hydrate is titrated with a solution of sulphuric acid of equal strength. From the total acidity the amounts of sulphuric acid and hydrofluosilicic acid previously determined are, of course, deducted.

A Graphical Chart for Determining Excess Air in the Combustion of Producer Gas*

The chart[1] reproduced was presented by Gordon M. Peltz of the Corning Glass Works at a meeting of the American Ceramic Society accompanied by a paper which consisted of a mathematical analysis of the combustion of the principal components of producer gas. In the paper, formulæ are obtained for determining the theoretically right proportions of air to gas for any analysis of producer gas and the theoretical volume of waste gases which should result from this combustion. In addition, a formula is determined by which the percentage of excess air can be obtained when the analysis of the gas and the percentage of CO_2 in the products of combustion are known. The calculating chart presents these formulæ in a form which eliminates the necessity for mathematical calculations.

Excess air is a very important factor, not only from the standpoint of fuel economy, but also in cases where the nature of the furnace atmosphere has an effect upon the operation involved. In spite of this, furnace operators rarely make determinations of the excess air, due largely to reluctance to take the time and trouble to make the necessary calculations as a regular daily routine. The desire to make a daily study of this question in a practical way led the author to reduce the whole calculation to chart form.

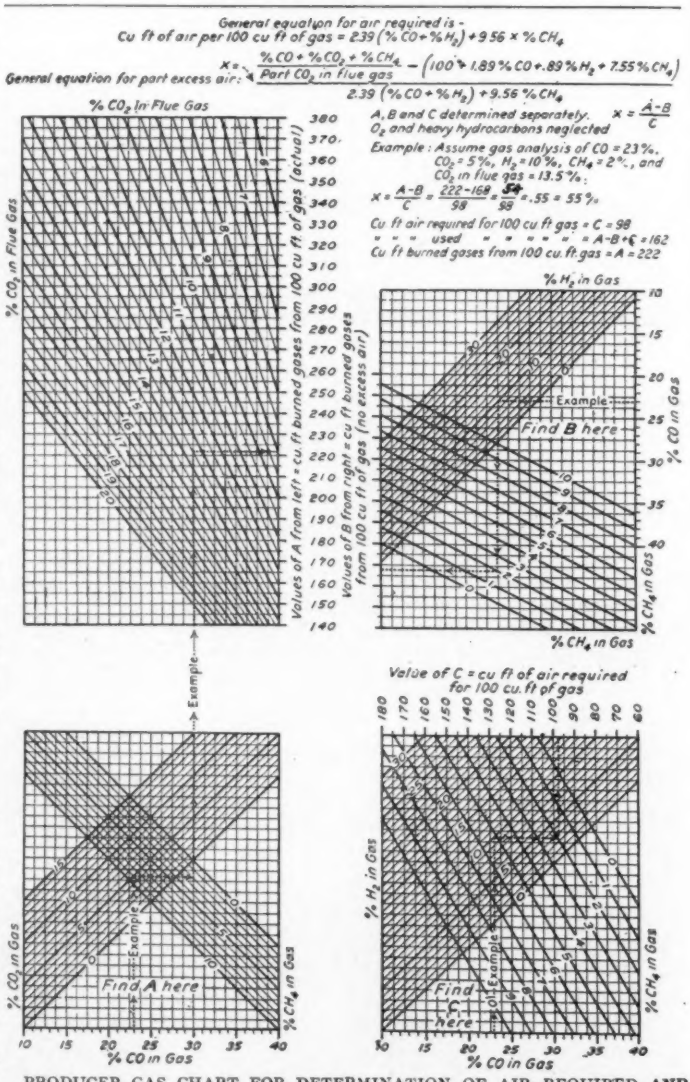
This chart has saved valuable time and has made practical a daily study of the excess air conditions in furnaces.

The presentation of the paper brought on a discussion, one of the members of the Society making the statement that if any dependence is placed upon the amount of carbon dioxide in the escaping gases it will be necessary to consider that if sodium carbonate is used in the melt, the carbon dioxide carried by that sodium carbonate is likely to appear in the escaping gases, and the amount of it from that source will depend entirely upon the vigor of the reaction which is taking place at that time, so that the mere presence of a given percentage of carbon dioxide in escaping gases will be an erroneous foundation on which to build a very elaborate calculation in regard to excess air.

Mr. Peltz replied that the point brought up was of interest and importance, not so much because of the magnitude of carbon dioxide which will be produced in most glass tanks, but because it brings up the importance of taking into account the practical conditions met with in a specific application of any general theory or calculation, such as that presented in his paper.

It should be noted that the purpose of his paper was to present only a simplified method of performing a mathematical calculation and he had not gone into the practical questions of obtaining the necessary gas samples and analyses. The chart, which was presented, applied to the general combustion of producer gases and was not intended exclusively for the glass business or any other business. It would, therefore, be necessary in considering its use under specific conditions to carefully consider what effect these conditions would have upon the results.

Replying specifically to the point raised by the member, he had made a rough calculation to determine approximately the magnitude of the carbon dioxide given off by a soft lime glass batch. Assuming a batch containing 22% sodium carbonate about 10% of the weight of this batch will be


General equation for air required is -
Cu ft of air per 100 cu ft of gas = 2.39 (% CO + % H2) + 9.56 x % CH4
General equation for part excess air: X = (% CO + % CO2 + % CH4) / (Part CO2 in flue gas) − (100 − 1.89 % CO + .89 % H2 + 7.55 % CH4) / 2.39 (% CO + % H2) + 9.56 % CH4
% CO2 In Flue Gas
% CO2 in Flue Gas
Values of A from left = cu. ft burned gases from 100 cu ft of gas (actual)
A, B and C determined separately. X = A−B / C
O2 and heavy hydrocarbons neglected
Example: Assume gas analysis of CO = 23%, CO2 = 5%, H2 = 10%, CH4 = 2%, and CO2 in flue gas = 13.5%:
X = A−B / C = 222−168 / 98 = 54/98 = .55 = 55%
Cu ft air required for 100 cu ft gas = C = 98
" " " used " " " " " = A−B+ξ = 162
Cu ft burned gases from 100 cu. ft. gas = A = 222
% H2 in Gas
Values of B from right = cu ft burned gases from 100 cu ft of gas (no excess air)
% CO in Gas
Example
Find B here
% CH4 in Gas
Value of C = cu ft of air required for 100 cu. ft of gas
% CO2 in Gas
Example
Find A here
% CH4 in Gas
% H2 in Gas
Example
Find C here
% CH4 in Gas
% CO in Gas

PRODUCER GAS CHART FOR DETERMINATION OF AIR REQUIRED AND EXCESS AIR FOR ANY GAS WITH ANY PER CENT CO_2 IN FLUE GAS. ALSO ACTUAL AND THEORETICAL VOLUME OF BURNED GASES FROM COMBUSTION OF 100 CU. FT. OF GAS.

* Presented at the Atlantic City meeting, February, 1924 (Glass Division). See *Journal of the American Ceramic Society*, Vol. 7, No. 6, June, 1924.

[1] Full size copies of this chart can be obtained by communicating with the author in care of Corning Glass Works, Corning, N. Y.

given off as carbon dioxide which, of course, mingles with the flue gases. Assuming a batch to cullet ratio of 1 to 1 it is apparent that the weight of CO_2 will be only 5% of the weight of the fill. Expressing this in volumes it is found that each pound of fill will produce 0.4 cu. ft. of CO_2. If 1 lb. of coal in the form of producer gas is required to every pound of fill, this will represent approximately 70 cu. ft. of producer gas which will require at least an additional 70 cu. ft. of air and will burn to at least 120 cu. ft. of non-condensable waste gases. About 17 cu. ft. of this total will be CO_2. It is apparent, therefore, that the CO_2 given off by the batch is not likely to be more than one-half of 1% of the total volume of waste gases nor more than 2½% of the total volume of carbon dioxide. There may be special cases, such as mentioned, which might depart considerably from the above rough calculations, but such cases would be rather exceptional and would have to be treated as such.

Mr. Peltz also laid down in his paper the general rules he had found useful in taking samples from glass tanks.

The Manufacture of Small Glassware in Czechoslovakia

Dr. Wilhelm Hannich*

Small pressed objects such as buttons, jewelry, solid and hollow pearls, watch glasses, cover glasses for pictures in brooches, flat or curved, are usually not made in a glass factory. The glass is put into the most convenient form for the object which is to be made, and is delivered at the workshop where it is treated further. Some articles are finished in the first workshop, others are only partly finished, and are passed through two or three shops until they are ready for use. Or they may leave the workshop of the glassmaker and be delivered to the metal shop, where they are put into their metal holders and are made ready for their ultimate use.

The most common form in which glass is suitable for many uses is the rod. For buttons, solid pearls, stones and all articles which are made in the workshop of the button manufacturer, the most desirable and handiest form of glass rod is two meters long and two centimeters in diameter. For very small pressed articles the length is one meter and the thickness 5 millimeters. The same length and thickness is chosen for hollow rods, for the manufacture of ordinary hollow pearls. In Thüringen they are a little longer, about one and a half meters. Lead glass for jewelry is delivered in both kinds of rods. Besides that, pieces of colored glass of the size of a fist or twice the size are obtainable.

For small cover glasses large spheres up to seventy-five centimeters in diameter are blown and then broken up. The glass is then sent to the workshops. The desired sizes are cut out with a diamond.

The drawing out of glass requires the skillful use of both hands. The chemical properties of glass are only considered in so far as the color of some colored glasses may change during working. Many glasses obtain the right color below a certain degree of temperature, even in the second fire, and the right time for the melting and cooling must be chosen for the manufacture of glass rods.

To make an ordinary rod, the glass worker takes a certain amount of glass from the pot, rolls it, heats it once or a few times until it is evenly melted and turns up one point with the tongs. This is grasped by the helper, who walks backward, holding the tongs rather low. The glass maker remains in his place and gives the rod a uniform thickness by moving it slightly. The rod can have any desired length, is drawn out from two to four meters and then broken up in pieces of convenient size.

Both kinds of rods, heavy and light, are made in the same way, only the thin ones are often made much longer.

In some lead glasses, for instance mother of pearl, the color does not appear until the second fire, and here the right moment for the drawing out of the rods must be selected. In the first fire the glass is melted in open pots. These are broken up and the glass is broken into pieces varying in size from a fist to a head. They are melted again in a special oven and shaped into rods. During this process the color appears to the best advantage. Even deep colors become light in the first fire and deepen in the second fire. The glass blower takes up a piece of glass, holds it over the flame and waits till the melting point is reached. As soon as the glass melts it becomes darker and soon shows a dull, silk-like texture. The glass blower must frequently cut off samples with the scissors and allow them to cool quickly so that he is able to judge the intensity of the color in the cold state. When the silk-like rays in the glass become clearer and finally appear to melt into one, the right moment for drawing out has arrived. This is done as described above. The necessary skill and accuracy in this line of work can only be obtained by practice and experience in the workshop.

The making of hollow rods is somewhat different from the solid rods. Since such rods are worked over again for other objects, not so much stress is laid on accuracy. The glassmaker takes a quantity of glass from the pot, works it thoroughly for some time and the helper makes a hole in the middle with a sharply pointed iron rod. Then the glass is heated again, and the rod is drawn out up to one hunderd meters. In Thüringen the glass is taken up on the blow pipe; it is then rolled and blown out. The helper takes some glass on an iron rod with a broad plate and touches the blown glass, which holds at once. Both workers step into the middle of the workshop and walk slowly in opposite directions while the glassmaker blows continuously and directs the side of the rod. The regularity of the rod and its quality depends on the skill of the glass blower and his assistant. If the tube is to be made of two layers of glass, the cylinder is covered with the desired kind of glass. In this way rods of every diameter are made.

The blowing of large spheres is the simplest method of making blown glassware, because the globes do not have to have a definite form or size. For this reason the mass of glass which is taken up is only of approximate size, and the sphere is blown after working the glass.

* Friedrichswald near Gablonz, Czechoslovakia.

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Readers of THE GLASS INDUSTRY in the United States and elsewhere are requested to favor the Editor with any information available from time to time concerning developments in their own or other fields which would be of general interest to the industry. Authoritative facts about new glass manufacturing projects, re-organizations, new factory construction, new processes and equipment, raw materials, manufacturing and market conditions, personal items, and other appropriate subjects would be welcomed.

Those experienced in the practical, technical or executive activities of glass manufacturing who are qualified and willing to lend their aid to the upbuilding and progress of the industry by giving from their store of knowledge to others, are invited to submit for publication articles on any subject relating to glass which would be of interest and value to our readers. The authors of accepted articles of this kind will be compensated at usual rates.

The Tariff on Glass

The recent closing of the Canadian Libbey-Owens Sheet Glass Company at Hamilton, Canada, should give food for thought to those who advocate the lowering of the existing tariff regulations in this country as a means of increasing the prosperity of the people in general.

The Canadian Libbey-Owens Sheet Glass Company started the erection of their plant in the fall of 1920, at which time the Conservative party, the protectionist party in Canada, was in power. The duty on common window glass was then as it had been for many years previous, 12½ per cent ad valorem on importations from all countries excepting Great Britain which had a preferential duty of 7½ per cent ad valorem. At that time practically all of the window glass used in Canada was supplied from Europe, the flat glass industry not having heretofore been established to any extent in Canada. Realizing the inadequacy of the existing tariff, coupled with the greatly depreciated European currency, the Conservative Government had promised to give sufficient protection to enable this industry to be established and to survive. Unfortunately, before the plant was completed and before effective legislation could be given, the Conservative Government was defeated and the Liberal Government known as the "Low Tariff or No Tariff Party" was returned to power. The Liberal Government alone had not a sufficiently large working majority to continue in power without the support of the Progressives who were numerically strong enough to hold the balance of power. The Progressives are largely in Western Canada and chiefly farmers banded together through common adversity due to the temporary failure of farming as a means of livelihood. However well they understood their own problems, they did not, nor did they seek to understand the more complex problems of the industrial life of Eastern Canada. Hence the Liberal Government supported by the Progressives pursued a policy of tariff reduction, having in mind only the demands of the agricultural communities and sacrificing labor and incidentally capital in the futile effort to correct their own misfortunes.

The Canadian Libbey-Owens Company, therefore, with an investment of approximately $2,000,000 and employing large numbers of highly skilled workmen, having a protection of only 12½ per cent against continental Europe could not compete with those countries whose currency had depreciated to the extent of only being worth a few cents on the dollar and the internal value of this currency being higher than its external. Thus in effect it was as if Canada not only enjoyed no protection but as if she had actually bonused the glass industry of Belgium, which was Canada's chief source of supply.

It is recognized now that the currency depreciation of the greater part of Europe is not going to be adjusted in a few years. That the cost of living in countries with lowered currency values will finally reach the level of world values is probably true but the fact remains that in many European countries this has as yet not taken place.

Aside from the difference of currency values, however, if the Canadian workmen had been content to labor the same long days and the same number of days and to tolerate child

labor, ignore certain Sabbath observances and the standards of education and social life as set up in this country and to work for the European rates of wages, then the Hamilton plant would have been in operation today.

The lesson to be learned from the treatment by the Canadian Government of the Canadian Libbey-Owens Sheet Glass Company is that insufficiency of tariff protection means inevitably either a lowering of the wages of men to meet the foreign competition or the complete unemployment of men by reason of the extinguishing of the industry itself.

Technical Consultation Service

Question 61. (From India) Cordy glass. In the factory in which I am working we are having a serious difficulty, viz: that we are getting cordy glass. The batch is as follows:

Sand	100
Soda	42
Lime hydroxide	16
Niter	2
Arsenic	2
Borax	2
Manganese	small quantity

The cords are very deceptive; one day we get them in large quantities, causing great wastage, while another day there are no cords.

In one pot (we use a direct fire pot furnace) we get the glass full of cords while the other is practically free from them. Will you please enlighten me on the cause of this?

Answer. In our opinion the cords are due to temperature conditions in the furnace. It is entirely possible that glass made from the same batch in two different pots located in the same furnace, may show cords in one pot and none in the other. It is an indication that the pot giving cordy glass is at a lower temperature than the other pots in the furnace.

We feel sure that careful pyrometric control of the furnace would be an aid in avoiding cords. Of course, it is realized that unless you are so situated that you can obtain not only good pyrometers, but also pyrometric service from the manufacturer, the installation of pyrometers often is a disappointment. Pyrometers must be kept in first class condition to give the desired results.

The composition of the glass, calculated from the batch is approximately as follows:

Silica (SiO_2)	73.00%
Sodium oxide (Na_2O)	18.2 %
Lime (CaO)	8.8 %

It is evident that the batch is not the cause of the cordy glass. Possibly an addition of borax to the batch might be helpful in eliminating this trouble.—J. B. K.

Question 62. Silvering Glass Vases. I am having trouble in silvering glass novelty vases. No matter how long I boil the glass either in lye, nitric acid or alcohol it will not come out bright, but will silver all over in different shades. Is it because the glass is of a cheap grade? Any information you can give will be appreciated.

Answer. If you are positive that your silver mixture is correct then your difficulties may be due to some impurities in the glass which leaves a surface on which the silver does not deposit satisfactorily. We would suggest that after cleansing the articles in your regular manner that you prepare a bath consisting of 1 gallon of water and 1 pint of hydrofluoric acid, immersing the glass in the solution for a moment or two, moving the article rapidly to and fro while in the solution. Rubber gloves must be used in all hydrofluoric acid solutions.

The difficulty may also be due to irregularities on the surface of the glass. Some of the cheaper kinds of glass have a rough surface. It is necessary that there should be a good polish on the glass, otherwise the deposition of silver is liable to be uneven and on such a surface silver does not deposit satisfactorily.

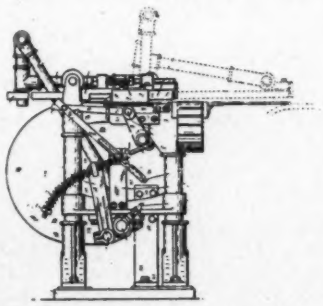
Recent Patents

NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

Copies of United States Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C. Price 10c each

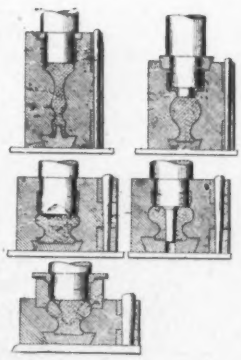
Lehr Feeder. U. S. 1,509,064. Sept. 16, 1924. William H. Johnson, Terre Haute, Ind., assignor to the Automatic Machinery Company, Terre Haute, Ind.

The inventor claims in a lehr feeder, a carrier for bringing ware to the mouth of a lehr, a push bar arranged alongside the carrier, a rock-shaft, connections between the rock-shaft and push bar by which the push bar may be swept laterally across the carrier, a cam acting on said rock-shaft, a stop finger movable into and out of the line of flow of ware to a position in front of the push bar, a second rock-shaft, connections between said second rock-shaft and the cam, an arm carried by the second rock-shaft, a pitman associated with said arm, a pair of oppositely acting springs arranged between said pitman and arm, connections between the pitman and stop finger, a catch carried by the stop finger and serving to retain the stop finger in flow-blocking position against the action of one of said springs, tripping means controlled by the first rock-shaft, and means acted upon by said tripping means for releasing said catch. Additional claims of the inventor are detailed in the patent specification.



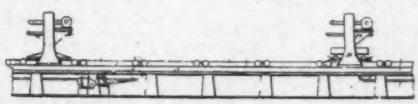
Method of Making Molded Glassware and Apparatus Therefor. U. S. 1,507,055. Sept. 2, 1924. Albert H. Forger, of Los Angeles, Cal.

This invention relates to methods of making certain articles of molded glassware of such form as to require the process of manufacture generally known throughout the trade as pressing through a well or on a fount, and apparatus therefor. It comprises a process of pressing glass wherein molten glass is placed in a cup or fount and pressed downwardly through the cup to a point adjacent the top of the mold, leaving a ring of glass to be removed from the top of the article.



Glass-Grinding Machinery. U. S. 1,508,378. Sept. 16, 1924. Edward T. Brown, Detroit, Mich., assignor to Ford Motor Company, Detroit, Mich.

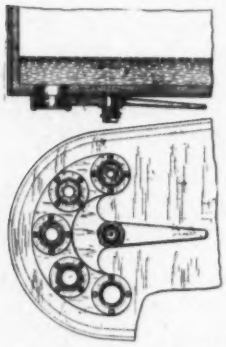
The inventor claims in the art of surfacing glass, and wherein the glass sheet is moved in a definite horizontal path beneath a fixedly-positioned instrumentality; a carrier for the glass-sheet and tracks on and be-



tween which it moves; a frame supported outside the tracks and extending over the carrier travel path; a surfacing unit mounted in the frame within spaced-apart upper and lower bearings, said unit including a surfacing element operating within the space below the lower bearing, and a shaft for rotating the surfacing element with the shaft mounted in the bearings; means for rotating the shaft and including a motor supported on the frame and having operating connections with the shaft within the space between said bearings; and unit-supporting and surfacing element positioning means operative to produce controllable gravity-pressure of the surfacing element on the sheet, said latter means including a rotatable adjusting element concentric with the shaft and positioned between the motor-operating connections and the lower bearing.

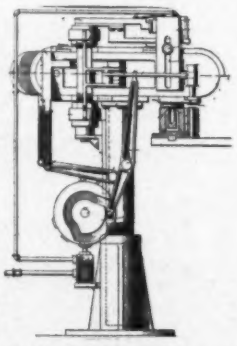
Glass Feeder. U. S. 1,507,852. Sept. 9, 1924. Claude W. Pleukharp and Harry Raynes, of San Francisco, Cal., assignors to Illinois-Pacific Glass Co., of San Francisco, Cal.

The object of the invention is to facilitate changing of spigots or plugs fitted to the discharge orifice of glass feeders and to eliminate waste in glass during the time of change. This is accomplished by using a movable plate fitting closely against the bottom of the tank or boot and having sliding contact therewith. This plate has one spigot or several of different sizes to register with the discharge orifice in the boot. Where the plate carries one spigot the old plate can be thrust out and a new plate simultaneously inserted, and where the plate itself has a plurality of spigots it is only necessary to move the plate to bring a new spigot into place. During the movement of the plate it serves as a closure for the discharge orifice and thus loss of glass is prevented.



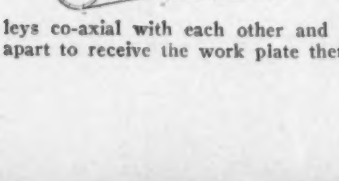
Bottle-Making Machine. U. S. 1,506,687. Aug. 26, 1924. Samuel G. Stuckey, of Warren, Pa.

The inventor claims in a bottle blank-forming machine, a series of two-part mold members comprising parison, blow and finishing molds, means for simultaneously opening and closing said mold members, a neck former operatively associated with said parison mold, a conveyer belt arranged to travel between said parison mold and neck former and in operative proximity to said blow and finishing molds, a plurality of neck molds carried by said conveyer belt and acting as transfer agents whereby the parison is carried successively from said parison mold and neck former to said blow mold and finishing mold, and means for imparting intermittent movement to said conveyer, timed to hold the neck molds in operative position with respect to said mold members.



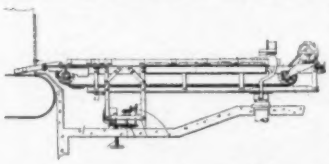
Corner-Smoothing Machine for Glassware. U. S. 1,506,745. Sept. 2, 1924. Harry O. Griffith, of Indianapolis, Ind., assignor to Marietta Manufacturing Company, of Indianapolis, Ind.

A machine comprising an endless abrasive belt supported horizontally on said machine, means for driving said belt, corner pulleys about which said belt is adapted to pass, a pair of pulleys positioned intermediate said corner pulleys co-axial with each other and having their ends spaced apart to receive the work plate therebetween for maintaining said belt in a given curvature against which the corners of the work may be engaged, a supporting table for the work so positioned as to support said work so that the corner to be ground will extend between said intermediate pulleys, and means for simultaneously adjusting the position of said table and intermediate pulleys with respect to said belt as to cause the work to engage different portions throughout the width thereof.



Lehr Conveyor. U. S. 1,507,301. Sept. 2, 1924. Percy G. Williams, of Cincinnati, O.

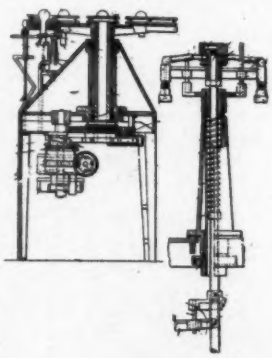
The device disclosed is for use in handling large bottles, such as gallon bottles and jugs, which because of their size, mass and heavy bases, cannot be handled on devices which up to this time have been employed with glass ware.



The inventor claims the combination of a bottle machine, a lehr conveyor, a primary conveyer comprising spaced sectional carrier plates, each carrier plate being adapted to carry individual ware from the bottle machine to the lehr conveyor, means to intermittingly actuate the primary conveyor transversely to the line of movement to the lehr conveyor between the lateral edges of the lehr conveyor, means to reverse the direction of movement of the primary conveyor upon arrival of the primary conveyor at its lateral limits of movement, and means to transfer ware from the carrier plates to the lehr conveyor while the means for effecting lateral movement of the primary conveyor is inoperative.

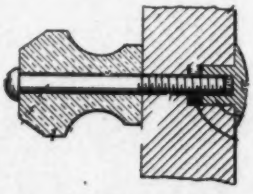
Machine for Cutting Glass. U. S. 1,508,358. Sept. 9, 1924. Carl A. Brown, of Toledo, O., assignor to General Electric Company.

Incandescent lamp bulbs made by automatic machines, especially those made from glass tubing, usually have a neck of excess length which must be cut off before the lamp can be used. In this invention the bulbs are inserted in a rotatable carrier which brings the neck of the bulb successively into the several operative positions. First, the neck is locally heated on the line at which it is to be cracked-off and the neck is cut and chilled on this line. The excess neck is then knocked off. The bulb is automatically removed from the rotatable carrier and deposited in a suitable container.



Knob for Furniture and the Like. U. S. 1,490,854. Apr. 15, 1924. Albertus J. Rutter, of Los Angeles, Cal.

A knob for use in connection with an article having parallel flat faces, an opening extending partly through the article from one of said flat faces and a recess opening onto the other of said flat faces and communicating with said opening and being of greater diameter than said opening, comprising a knob body having broad, flat, inner and outer faces connected by an axial bore, a bolt whose length is less than that of the combined thickness of the knob body and the article with which the knob is engaged, said bolt adapted to extend through the opening in the article and to terminate in the recess between the ends thereof, and a nut co-acting with the bolt and having a cylindrical extension adapted to rotate in said recess and to be held by the walls thereof in a permanent plane with the bolt and provided with a flat head adapted to bear against one of the flat faces of the article and to force one of the flat faces of the knob against the other flat face of said article.



Glass Factory Equipment and Supplies

THE GLASS INDUSTRY will be glad to publish descriptions of new and useful devices, machinery and supplies of interest to the glass manufacturing trade. Most of the information printed in this department comes direct from the manufacturers of the products described.

Checker Tile in Glass Melting Furnaces*

The Importance of Checkers

Inasmuch as the majority of glass melting furnaces are of the regenerative type, regenerators are deserving of close study. The successful operation of a regenerative furnace is dependent upon the checkers to a greater degree than any other part of the furnace.

The primary function of checker tile is to absorb heat from the waste gases and in turn give up this heat to the incoming air or gas upon reversal of the furnace. The checkers are not required to resist the high temperatures to which the interior of the furnace is exposed, they can however fail if not made of the proper fire clay material, through fluxing due to alkaline dust carried over with the gases.

Checkers are subjected to comparatively high temperatures and to the action of dust carried over with the waste gases. This dust as a rule is high in soda and lime. The temperature attained by the checkers and the amount of fluxing action taking place between the dust and the brick depends both upon the operation of the furnace and the composition of the batch in the tank. When the furnace is pushed the temperatures are high and the velocity of the gases correspondingly great, which results in an increased amount of corrosive dust being carried over.

How Checkers Can Fail

Checkers are not seriously affected by temperature changes, for while the furnace is in operation, the lowest temperature reached is above the spalling point of the fire clay material. The dust, however, which comes in contact with the checkers can ultimately cause failure either through excessive corrosion due to high temperature and a rapid solvent action or by sintering sufficiently to cause the brick to stick together. With the lower grades of fire clay checkers it is not unusual for the slag formed, due to corrosion of the top courses, to drip and freeze on the lower or cooler checkers thereby clogging the openings. This causes improper distribution of the gases through the checker chamber.

Checkers which corrode rapidly not only cause trouble through clogging of the openings, but become thinner in section and vitrify, thus losing their regenerative quality. It is well known that a vitrified checker does not absorb and give up heat efficiently and checkers which become thin in section are not desirable. If the dust has fritted to the surface it must be chiseled off, which results in considerable breakage. If the checkers are stuck together by slag they must be broken apart and the salvage is small. It is advantageous therefore, to use checker tile which are not rapidly attacked by the dust and gases.

Checkers of Proved Quality

To determine the service which could be expected from checkers varying in chemical and physical composition, eleven samples were tested, ranging from silica brick to fire clay material high in alumina. These samples represented the best materials obtainable from both the Eastern and Western territory and two regenerative tank furnaces were employed so that actual operating conditions could be obtained.

These tests extended over a period of seven months and were supplemented by laboratory slag tests. The latter procedure consisted of fusing cones made up from mixtures of the various checker materials together with the dust which caused corrosion. The research work along this line proved that there is a general relation between the amount of slagging action taking place in the regenerator and the fusion point of the mixtures of slag and brick.

Proper Size of Checkers

Another factor which has been subject to recent study by engineers is the size of the individual checker tile and the method of placing them in the regenerators.

For sound engineering reasons we have never advocated standard 9-inch brick for checkers and have long standardized and carry in stock checker tile of three by six-inch section, varying in length from fifteen to twenty-four inches.

We have found that a more stable structure resulted in building up checkers from tile of these sizes, also that they could be more accurately spaced and set with less labor. Careful scientific investigation has also shown us that for twenty to thirty minute reversals, which is accepted practice, the 3-inch thickness of checker is ideal for maximum heat storage per weight of tile. We find that with this time period between reversals, the temperature of the central plane in the 3-inch tile is about ninety-two per cent of the surface temperature. This means that after twenty to thirty minutes exposure to the heat of the waste gases that the 3-inch checker tile are heated in the center to about ninety-two per cent of the temperature of the surface, resulting in practically maximum heat storage capacity.

Checkers that are thinner than three inches result in high operating costs, for they reach the heat saturation point too rapidly and the heated gases then pass through the regenerators only resulting in uneconomical high temperatures at the chimney. The other extreme would be checker tile of greater thickness than three inches which perhaps would not affect the operating costs but would reflect in the first cost, in that the volume and weight of the checkers would be too great for the corresponding heat storage capacity.

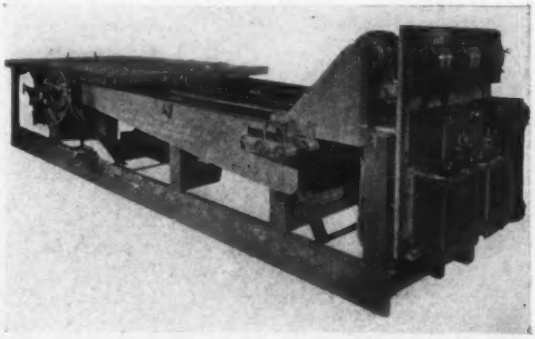
Essentials in Regenerator Design

One thing should be said about the design of regenerators which is borne out by the best modern practice and that is to make the checker chambers both for the air and gas sides as deep as possible. Also to make the space above the checkers ample enough to discourage convection eddy currents and allow the gas to flow into the ports with the least possible friction. The flues below the checkers which feed the air and gas to the regenerators should be of generous proportions so that the proper distribution is obtained under the full length of the checkers. Velocities of the gases which are too low or too high no doubt result in improper heat transfer but when the regenerators are properly designed velocities of the gases will equalize themselves in the various portions of the checker chamber.

*From a booklet by Laclede-Christy Clay Products Co., St. Louis, Mo.

New Mitering Machine

The new mitering machine shown here has been put on the market by the Automatic Machinery Company, Terre Haute, Ind. The original purpose of this machine was to do straight mitering, but beveling and polishing can also be done on it in a satisfactory manner. The first machine of this type to be completed was shipped to the Nurre Mirror Plate Company, Burlington, Iowa.



NEW MITERING MACHINE

The capacity is a 6-foot plate of glass, although machines to handle any size of sheet can be made. The equipment is of sturdy construction. The shafts on which the table travels are ground and polished. General Electric reversible speed motors are used. The machine has two hubs on which grinding or polishing wheels can be attached.

DINNER OF THE PITTSBURGH SECTION OF THE AMERICAN CERAMIC SOCIETY, AT THE UNIVERSITY CLUB, PITTSBURGH, PA., SEPTEMBER 4, 1924, IN HONOR OF PROF. W. E. S. TURNER, HEAD OF THE DEPARTMENT OF GLASS TECHNOLOGY, THE UNIVERSITY, SHEFFIELD, ENGLAND, AND DR. J. W. MELLOR, SECRETARY OF THE CERAMIC SOCIETY, ENGLAND

Pittsburgh Ceramists Entertain Distinguished English Guests

The dinner given Thursday evening, September 4, at the University Club, Pittsburgh, Pa., by the Pittsburgh Section of the American Ceramic Society to its guests of honor, Prof. W. E. S. Turner, head of the Department of Glass Technology of The University, Sheffield, England, and editor of the *Journal of the Society of Glass Technology*, and Dr. J. W. Mellor, a very prominent chemist and secretary of the Ceramic Society, of England, proved to be even more of a success than was anticipated. About 85 persons attended including a number of members of the Pittsburgh branch of the American Chemical Society, which was invited to participate.

J. W. Cruikshank, president of the J. W. Cruikshank Engineering Company and chairman of the Pittsburgh Section, opened the meeting and introduced Prof. Alexander Silverman, head of the Chemistry Department of the University of Pittsburgh, as toastmaster.

Prof. Turner was the first speaker and referred to his pleasure in being in Pittsburgh once more. Having previously enjoyed the hospitality of the city he felt at home. He was there in 1920 with a delegation from the Society of Glass Technology who visited many glass plants throughout the country. He said he considered it a compliment when the manager of a factory which he visited recently remarked that he supposed that Prof. Turner knew practically all the glass plants in America and later remarked, "I suppose you spend a good deal of your time in England." Prof. Turner said he was willing to be taken as an American and felt that it was one of the most sincere compliments that had ever been paid him.

He stated that the invitation of the Society of Glass Technology to the American Ceramic Society to visit England was still open and that he knew the Society would have a warm welcome not only from himself, but from the Ceramic Society which was represented at this dinner by his colleague, Dr. Mellor, who had been for so many years connected with that society.

Prof. Turner stated that notice of the fact that he was expected to speak that night came into his hands only that afternoon after following him around the country for several days and that he had little time to compose his thoughts. Nevertheless he spoke very interestingly on a number of subjects of importance to the trade. Regarding conditions in Great Britain, he said that in some ways they were parallel to those in this country. In 1920 both countries enjoyed exceptional prosperity but by the end of that year there was a turn and a serious slump set in very suddenly. Prosperity returned to the United States, but England, unlike America, has not recovered her position.

On the subject of cut glass, Prof. Turner said that he believed the manufacture of so many motor cars in America had a great influence on the country and that their extensive use has taken the wife from the home so that she does not care to bother about the cut glass that was once so popular. This, he believed, was the cause of the practical discontinuance of the manufacture of cut glass in the United States, while in England fewer cars are manufactured and cut glass manufacturers are still busy.

Prof. Turner referred to the work he and his colleagues were doing on the viscosity of glass and the taking of measurements of the range of temperature at the viscosity point. The results of this work will be extremely valuable to glass manufacturers.

On the question of the value of research to the manufacturer, Prof. Turner expressed a positive belief in its benefits and referred to the great advances made as a direct result of research. He was suprised that more interest was not taken in research in this country and could not understand how the American glass industry could continue to progress without establishing a center for research. He recognized also the value of the work of the practical man but felt that the industry as a whole has been slow in applying the lessons learned in research to practical use in the factory. At present research is considerably in advance of factory practice. He brought out three points.

1. Scientific work is desirable.

2. Observations of the so-called practical man should be respected.

3. However valuable our researches may be and however active we may be in practical research, until our industry is more acute to the fundamental things of science then our researches are in a large measure almost wasted. They are kept for some future generation when they might be applied here and now.

The speaker quoted an experience in melting glass that he had had at Sheffield University with a practical man. It had been observed that at times glass made by two different persons from the same formula and the same materials produced markedly different results. It was found upon investigation in one case that one of the batches had been mixed dry and the other wet. A test was decided upon and wet and dry batches were made up and without giving the workmen any information as to what was being done, the two batches were worked at the same time. A scientific man was put on to analyze and test the glasses along technical lines. Reports from both coincided perfectly, showing that water in the batch had an appreciable effect on the glass, the glass made from the wet materials being of a decidedly different nature from that produced by the dry raw materials. The admixture of a salt that is volatile was found by the practical man to have a real effect on glass, a fact which was confirmed by scientific investigation.

Dr. Mellor, who is the author of many well known books on chemical and ceramic subjects, made an address along humorous lines. Among other things he stated that the society of which he was secretary was divided into three factions; one of which pronounced ceramics with a hard C, one affected a soft C, and the third faction did not care a d——— how it was pronounced. Referring to Prof. Turner's statement as to the effect of water in the batch, he stated that he thought this was due to the delay in chemical reactions caused by the water in the wet batch holding the molecules apart in the preliminary heating of the batch so that they were longer delayed in combining than those in the dry batch. This would affect the time of melting and consequently the quality of glass. Similar conditions are found in a number of commercial processes and bread making was cited as a case in point.

Ross C. Purdy, general secretary of the American Ceramic Society, who had made a special trip from Columbus to be present at the meeting, responded with his usual energy and good feeling to an invitation to address the members.

Prof. L. K. Manley, Dean of the School of Economics, University of Pittsburgh, gave a talk on the Republican and Democratic conventions and pointed out our duty to not neglect our rights of suffrage.

Chancellor J. G. Bowman of the University of Pittsburgh was an honor guest and gave a short talk on industrial problems and the necessity of bringing the industry together from the psychological point of view. While technical and research men had their uses he believed it quite as important to devote scientific study to questions of human relations between the workmen and executive staffs of the factories. He thought that the technical men worked along too narrow lines and that while it was possible for them to produce in a remarkable way by means of experiments and research anything the manufacturer wanted, he believed that some time and thought should be given to solving the problem of restlessness and dissatisfaction among the workmen.

Following is a list of those who attended the dinner.

SPEAKERS' TABLE. J. W. Cruikshank, Prof. Alexander Silverman, Ross C. Purdy, Prof. and Mrs. W. E. S. Turner, J. W. Mellor, Chancellor J. G. Bowman, Prof. L. K. Manley, Mr. and

Mrs. E. Ward Tillotson, Mr. and Mrs. H. L. Dixon, A. V. Bleininger, Louis Reizenstein.

TABLE No. 2. Cyrus G. Dunkle, John F. Byrne, Mr. and Mrs. Sanford S. Cole, R. F. Ferguson, R. A. Robinson, J. E. Hanson, B. M. Larson, Chas. R. Fettke, Chas. Watkins, C. E. Greider, Chas. L. Jones, Gordon R. Pole, G. E. Meiter.

TABLE No. 3. L. O. Peterson, Mr. and Mrs. H. J. White, Mr. and Mrs. C. R. McCann, Mr. and Mrs. Harry Willetts, D. W. Loomis, Mr. and Mrs. F. M. Ritchie, Mr. and Mrs. T. F. Harnock, Mr. and Mrs. H. G. Dixon.

TABLE No. 4. Miss McKillop, Donald W. Ross, John M. Hammer, George S. Cooper, F. C. Flint, A. H. Wright, Horace Foster, Jr., G. W. Cooper.

TABLE No. 5. Mr. and Mrs. A. W. Kimes, M. G. Babcock, Mr. and Mrs. R. E. Kimball, Wm. J. Miller, V. G. Greene, F. A. Rotandaro.

TABLE No. 6. Joseph Heidenkamp and Miss Heidenkamp, Mr. and Mrs. Heidenkamp, Jr., W. A. Turner, Thos. MacConnell, Jr., J. O. Handy.

TABLE No. 7. Mr. and Mrs. Harry S. Hower, H. H. Blau, C. A. Simpson, W. E. Daugherty, H. R. Urbach, W. F. Wenning, H. V. Huber, J. B. Luckie, Glenn D. Williams.

TABLE No. 8. C. H. Walker, R. J. Weithorn, H. S. Robertson, E. P. Arthur, Mr. Stewart, J. M. Manor, T. A. Shegog, H. A. Thrun, C. L. Kirk.

The Glass World and What It Is Doing

News of the Industry

Glass Distributors' Meetings

The Western Division of the National Glass Distributors' Association held a meeting at the Congress Hotel, Chicago, Ill., on September 9. The meeting was addressed by Warren Hires Turner of the Standard Plate Glass Corporation, who pointed out that not only in the glass industry had price adjustments become necessary but that in the iron and steel, coal, automobile and other industries, similar action had been taken. In spite of the present conditions he felt that on account of the constantly increasing population of the country and continuous building activity and for other reasons, the demand for glass would continue to be good and that he looked forward with confidence to better business conditions this fall for glass distributors.

Others who addressed the meeting were: H. B. Higgins of the Pittsburgh Plate Glass Company; H. J. Walter, president of the Interstate Window Glass Company; C. E. Ryan of the Western Glass Company; J. R. Johnston of the Johnston Brokerage Company; T. P. Geoghegan, Libbey-Owens Sheet Glass Company, and W. L. Munro, president of the American Window Glass Company who spoke on glass manufacturing conditions in Europe, giving his observations made during his recent trip there. C. J. Gundlach, president of the Mississippi Glass Company, who had also been in Europe described conditions as he saw them in several foreign countries. Pilkington Brothers Company, of England and Canada, was represented by Mr. Taylor, who gave a brief talk to the members.

The first fall meeting of the Eastern Division of the National Glass Distributors' Association, at the Hotel Traymore, Atlantic City, N. J., was attended by an unusually large number of members.

The business meeting on September 17 was addressed by S. C. Gilmore of the Hires-Turner Glass Company, chairman; E. V. Jacka, president of the National Glass Distributors' Association, and North Storms, secretary of the association; J. R. Johnston, of the Johnston Brokerage Company; W. L. Munro, president of the American Window Glass Company; C. J. Gundlach, president of the Mississippi Glass Company; Warren Hires Turner, of the Standard Plate Glass Corporation; T. P. Goeghegan, sales manager of the Libbey-Owens Sheet Glass Company; Paul Nesbit, of the National Plate Glass Company; J. Scott Walker, of the Interstate Window Glass Company; H. B. Higgins, of the Pittsburgh Plate Glass Company and a number of other manufacturers and distributers.

A general feeling of optimism as to the prospects for fall and winter business prevailed.

In the course of his talk, Mr. Munro stated that records for the period from September 1, 1923, to September 1, 1924, would show a reduction of three and one-half million 50-foot boxes from the corresponding period of 1922-1923, amounting to about 30 per cent. Hand plant production also was greatly reduced. Stocks in the hands of jobbers are at their lowest ebb and the manufacturers' stocks are also low. No further reduction in prices of window glass is contemplated.

Great interest was aroused by Mr. Munro's statement that in order to protect the manufacturer and at the same time benefit the jobber the American Window Glass Company will make a practice of placing a quality slip describing the contents in each box of glass. The absence of brands and misbranding was the cause of poor quality glass being sold at high prices and it is to prevent such practices that the new quality slip plan is to be adopted.

The social features of the gathering included a dinner and dance in the Rose room of the Hotel Traymore on Wednesday evening and a golf contest at the Linwood Golf Club on Thursday.

The next meeting of the Eastern Division will be held at the Hotel McAlpin, New York, on Wednesday, October 29.

Bottlers' Annual Exposition

About 132 concerns manufacturing bottlers' equipment and supplies have reserved 243 of the 263 spaces available at the exposition to be held in conjunction with the annual convention of the American Bottlers of Carbonated Beverages at Louisville, Ky., November 10 to 14. Among the firms to exhibit are numerous manufacturers of glass bottles and containers including: American Bottle Company, Toledo, O.; Charles Boldt Glass Company, Cincinnati, O.; Chattanooga Bottle & Glass Manufacturing Company, Chattanooga, Tenn.; George F. Collins & Company, Sapulpa, Okla.; D. O. Cunningham Glass Company, Pittsburgh, Pa.; Graham Glass Company, Evansville, Ind.; Illinois Glass Company, Alton, Ill.; Pierce Glass Company, Port Allegany, Pa.; F. E. Reed Glass Company, Rochester, N. Y.; and the Root Glass Company, Terre Haute, Ind.

The Armstrong Cork Company, Pittsburgh, Pa., manufacturers of corks, Nonpareil insulating brick, etc., and the J. B. Ford Company, Wyandotte, Mich., manufacturers of Wyandotte cleaners will also exhibit.

Publicity for Tax Returns

The United States Treasury Department has issued a pamphlet, Regulations 64 (1924 Edition), relating to the capital stock tax as revised under the Revenue Act of 1924. This act provided for a special excise tax with respect to carrying on or doing business. The pamphlet gives the main provisions of the law and interpretations of them.

The special tax on domestic corporations is $1.00 for each $1,000 of so much of the fair average value of its capital stock for the preceding year ending June 30 as is in excess of $5,000. The pamphlet gives information regarding the required returns, exemptions allowed from taxation, methods to be followed in claiming exemptions, etc. It will be remembered that the Revenue Act of 1924 provides that all returns shall constitute public records but they shall be open to inspection only upon the order of the President and under rules and regulations prescribed by the Secretary and approved by the President, and that the Committee on Ways and Means of the House of Representatives and the Committee on Finance of the Senate, or a special committee of the Senate or House, shall have the right to call on the Secretary of the Treasury for any data contained in the returns. State officers or committees also may have access to the returns.

Bona fide shareholders of record holding one per centum or more of the outstanding stock of any corporation shall, upon making request of the Commissioner of Internal Revenue, be allowed to examine the annual income returns of such corporations and its subsidiaries, but such shareholders must not make known in any manner whatever not provided for by the law, the amount or source of income, profits, losses, expenditures or any particulars thereof, that may be discussed in any such return.

The law also provides that the Commissioner prepare and make available to public inspection in such manner as he may determine, in the office of the Collector in each Internal Revenue district and in such other places as he may determine, lists containing the name and the post office address of each person making an income tax return in such district, together with the amount of the income tax paid by such person.

Copies of the pamphlet referred to above may be obtained from the Superintendent of Documents, Washington, D. C., at 5 cents each.

Standard Plate Glass Semi-Annual Report

The report of Standard Plate Glass Company for six months ended June 30, 1924, shows net profit of $683,157 after expenses, interest and depreciation, equivalent after allowing for preferred dividend requirements to $2.06 a share earned on outstanding 200,000 no par common shares. Consolidated income account for six months ended June 30, 1924, follows:

Gross sales	$4,008,325
Cost of sales, depreciation, etc.	2,650,661
Expenses	639,652
Operating profit	$718,012
Other income	83,616
Gross income	$801,628
Interest, etc.	118,471
Net profit	$683,157
Dividend	420,167
Surplus	$262,990

Hazel-Atlas Semi-Annual Report

The financial statement of the Hazel-Atlas Glass Company, Wheeling, W. Va., for the first six months of 1924, issued by President J. C. Brady, shows a net gain for the parent company and its subsidiaries of $520,500. Details follow:

Total income after deducting for repairs and maintenance amounting to $374,018.69		$ 935,647.47
Less:		
Provision for general depreciation	$326,949.46	
Interest on bonds and borrowed money	88,197.73—	415,147.19
Net gain for the six months		$ 520,500.28
SURPLUS		
Surplus at December 29, 1923		$1,835,324.82
Increase—Net gain for the six months ending June 28, 1924		520,500.28
		$2,355,825.10
Deduct:		
Two quarterly dividends of 2% each		450,746.00
Net surplus at June 28, 1924		$1,905,079.10

Wm. J. Miller Concern Incorporated

The Miller Glass Engineering Co., of Swissvale, Pa., celebrated the sale of its 100th feeder in the United States by taking out a Pennsylvania charter. The Miller Glass Engineering Co. for economic reasons was originally organized March 21, 1919, as a Declaration of Trust or Common Law corporation in which the entire business was controlled by a board of three trustees. Due to increased handicaps under which Common Law corporations are obliged to operate, it was decided to incorporate.

The new company assumes all the assets, liabilities, contracts, etc., of the Common Law corporation, and will continue the business as formerly. It owns the Wm. J. Miller blowback type feeder patents, and the number that are in operation attests the popularity and success of their product.

The chartered company is capitalized at $100,000. The incorporators and directors are H. A. Cusack, A. E. Mildon, and Wm. J. Miller, all of Swissvale, Pa. The officers are: Wm. J. Miller, president, and H. A. Cusack, secretary and treasurer.

New Composition Mold

The Automatic Glass Products Company, Nicholas Building, Toledo, O., have begun production on two tanks at the plant of the Western Glass Company, St. Marys, W. Va., of electric bulbs, using the newly invented composition mold which they control and which for the past month they have been proving out in commercial production. The mold composition contains a large proportion of graphite and is cast or fitted into a comparatively thin iron casing. The graphite, it is claimed, gives the glass a very high finish and makes the use of paste molds unnecessary. It is also claimed that the molds have a long life due to the fact that they radiate heat very rapidly. The company plans later to add to its line the manufacture of tumblers, stemware and thermos bottles, and to equip a large continuous tank with machines. There are also two additional day tanks at the plant which can be utilized. Operations are being conducted under the supervision of Dr. Henry W. Hess of Toledo, O.

Austin Company Contracts

The Whitall-Tatum Company, Millville, N. J., manufacturers of pharmaceutical glassware and rubber goods, have awarded a contract to the Austin Company, Cleveland, O., for the construction at its main plant of a large storage warehouse. The building is to be 80 by 350 ft., of one-story steel frame construction. Approximately 200 tons of steel will be required. Construction and all material purchases will be handled through the Philadelphia office of The Austin Company, whose main office at Cleveland, O., also reports two new contracts with the Hocking Glass Company, Lancaster, O. Since the contract was awarded to the Austin organization after the recent disastrous fire for rebuilding the original Hocking plant comprising eight buildings, two additional units have been added. Most of the new buildings are of fireproof construction. The Austin Company has also contracted to erect a new steel frame woodworking shop for the Hauser-Stander Tank Company, Cincinnati, O., manufacturers of wood tanks for pickling, water storage, chemicals and other purposes.

J. Howard Fry Now with Libbey Glass

Early in September it was announced by J. W. Robinson, vice-president of the Libbey Glass Manufacturing Company that J. Howard Fry, formerly vice-president of the H. C. Fry Glass Company and the Beaver Valley Glass Company, both of Rochester, Pa., had become associated in an official capacity with that company. There has been no change in the personnel of the Libbey company and Mr. Fry goes on as an addition to the staff and does not replace any of the former members. He is a prominent figure in the industry and takes to his new connection long years of experience in both manufacturing and sales work. He will act in an executive capacity concentrating his efforts on the promotion and production of Libbey Safedge Glassware.

Flint Glass Workers' Scale Continued

A final joint conference of the punch tumbler and stemware departments of the National Association of Manufacturers of Pressed and Blown Glassware and the American Flint Glass Workers' Union was held on September 3 at the office of the Association in Pittsburgh, Pa., at which time the situation in these departments was thoroughly discussed and an agreement made that the present wage scale shall remain in effect until September 1, 1925.

Wage Reductions

A reduction in wages averaging about 10 per cent has been arranged between the Window Glass Cutters and Fasteners Protective Association and the American Window Glass Company. The new scale calls for 37 cents per 50-foot box for

single strength cutters and approximately 45.9 cents per box for double strength.

The hand window glass workers have accepted a reduction of 25 per cent from the scale in force during the past year, this arrangement to hold good until September, 1925.

Trade Activities

The National Window Glass Workers, Cleveland, O., have moved their offices from 1103 Ulmer Building to 712 Park Building.

The Ornamental Glass Works, New York, has been incorporated with a capital of $10,000, by A. Steinberg, and J. J. Weinblatt. M. M. Simon, 305 Broadway, New York, is attorney for the company.

The United States Sheet & Window Glass Company, Toledo, O., whose factory is at Shreveport, La., has opened a western sales office 306 Commerce Trust Building, Kansas City, Mo., in charge of H. W. Bell, formerly of Toledo.

The Russell Engineering Company, St. Louis, Mo., have been awarded the contract for remodeling the factory of the Scohy Sheet Glass Company, Sistersville, W. Va., and for a complete installation of Fourcault sheet glass drawing machines.

The Southeastern Plate Glass Company, Montgomery, Ala., has been organized with a capital of $50,000 to manufacture mirrors and plate glass show cases and windows. The company will operate grinding, polishing, beveling and mitering departments. F. R. Haynes is president and general manager.

It is reported that suit for foreclosure of a mortgage on the **Licking Window Glass Company's** properties, at Utica, O., has been brought by the Cleveland Trust Company, which is said to have provided funds in 1923 for the company's use by issuing 10 year first mortgage 8 per cent sinking fund gold bonds in the sum of $150,000.

A large tank at the **D. C. Jenkins Glass Company's** factory at Arcadia, Ind., burst at 2 o'clock on the morning of September 13 while the night shift was at work. The resulting fire caused a loss of several thousands of dollars and will prove a hard blow to the two hundred men and girls who will be thrown out of work for the next six or eight weeks while the tank is being repaired.

H. A. Schnelbach of Long Beach, Cal., has incorporated the **Specialty Glass Company,** with himself as president and H. R. Fay, secretary of the Long Beach Chamber of Commerce, as secretary and treasurer, for the purpose of obtaining $600,000 capital and erecting a modern glass factory. The plans call for a 25-ton continuous tank and four 5-ton day tanks. It is stated that the company will enjoy special advantages as fuel oil, gas and cheap power are to be had in abundance.

W. N. Mathews, vice-president and secretary of the **Brilliant Glass Company,** Brilliant, O., reports that their application for a patent covering the raised and depressed two color stop and tail light lens has been allowed and that instructions have been issued to start suits against eight large glass manufacturers and eleven lamp manufacturers who have been selling this product and that later on suits against dealers will also be instituted.

Fire of undetermined origin destroyed the chemical storage and mixing departments at the plant of the **Marietta Manufacturing Company,** Indianapolis, Ind., makers of table and counter tops, etc., at an estimated loss of $20,000. The chief damage amounting to $15,000 was to stored chemicals which were ruined by water. The damage to the building from the flames did not exceed $5,000. The company reports that no time was lost at the factory on account of the fire.

The Wheeling Glass Manufacturing Company, Wheeling, W. Va., are making progress in remodeling the old plant of the North Wheeling Glass Bottle Company, which they purchased in August, and are installing equipment for the manufacture of decorated and undecorated table ware. A. J. Rowing is supervising the work and David Baird, formerly connected with the Eagle Glass Company, Wellsburg, W. Va., will be in charge of sales. About 100 employes will be put to work when the plant opens.

The Mirroscope Company of America, Inc., a new corporation comprising entirely new interests, has taken over the material assets of the Alexander Mirroscope Company, Inc., Port Chester, N. Y., one of the oldest and largest exclusive manufacturers of mirroscopes for passenger automobiles and motor trucks. Those interested in the new concern include L. D. Harr, formerly vice-president of the Graton & Knight Manufacturing Company, Worcester, Mass., and J. F. Barnet, formerly chairman of a subsidiary company of the Firestone Tire & Rubber Company, Akron, O.

Notice has been given that an application has been made for a Pennsylvania charter for an intended corporation to be known as the **Elk Run Window Glass Manufacturing Company,** Punxsutawney, Pa., by Abe Keslar, Rene Delmotte, M. S. Reams, Roger Colombin and Gaspar Trunzo. Some weeks ago it was reported that plans were being worked out for the purchase of the plant, which has been idle for some time, from its owners by the employees, who would agree to apply half of their earnings for the definite period to the purchase of stock in a new organization.

The Central Glass Company of Virginia has taken over the Kendle-Collins Glass Company, of Cincinnati, O. The former, which is a subsidiary branch of the Central Glass Company, of Kentucky, has completed a new building, at Bristol, Va., which it is said will house the largest and most modern mirror plant in the South. In addition to manufacturing mirrors for the furniture trade and framed mirrors the plant will job building glass including plate, rough wire and window glass. The jobbing department will be opened October 1 and the mirror manufacturing department about October 15.

The plant of the **Libbey Glass Manufacturing Company,** Toledo, O., was reopened on September 2 with three eight-hour shifts employing about 1,000 men. The plant had been closed for the entire month of August. The company at present has one 16-pot furnace and two tanks in operation. One additional tank is being prepared for operation October 15 and another for production the latter part of October. They also plan to put another tank in operation in November, while one more 16-pot furnace is being prepared for production as quickly as possible and they contemplate lighting up an additional 16-pot furnace the latter part of October.

In order to conserve the resources of the **Continental Flat Glass Company,** Shreveport, La., officers and directors of the company voluntarily filed a petition for a receiver on September 2. W. K. Henderson, formerly chairman of the board of the company, was appointed receiver. This action is said to have been taken in order to relieve the company of all annoyances caused by the manufacturing and financial difficulties met with in putting their new Fourcault sheet drawing plant into operation. The receivership is entirely friendly and is expected to be only temporary.

The Columbia Cement Company, Los Angeles, Cal., has been re-organized with an increased capitalization, now $6,000,000. With this increase it will now be possible for it to develop its vast holdings which include 8,900 acres near Coyote Wells in Imperial County, California. Besides portland cement and marble, the company, it is reported, will manufacture other products including glass. The deposits at Coyote Wells consists of limestone, marble and micaceous schist, feldspar, silica sands, shales and clays. Fred A. Ballin is president of the Columbia Cement Company. He was formerly the head of the Monolith Portland Cement Company, of Los Angeles.

The Anaheim Glass Company, Long Beach, Cal., has started construction work on the first unit of their new factory located there. The building now being erected is 60 x 140 ft. in size and is to be of fireproof construction entirely. It is expected to bring in about forty families of skilled glass workers when the first unit is ready for operation. The plant will be devoted exclusively to the manufacture of glass novelties, for which Thomas McBride, one of the financers of the company, states there is a big market in this section which is now inadequately supplied. Associated with Mr. McBride in the company is his son, Charles McBride. The company's plant at Salem will be discontinued as conditions there are unfavorable for glass manufacture and most of the machinery will be moved to the Long Beach factory. The Shreveport

plant of the company has been sold, leaving but the Anaheim plant under this management, on which all their efforts will be directed.

The Long Beach Glass Company, Inc., has been taken over by Los Angeles interests and a complete re-organization has been effected. The company's plant is located on Daisy avenue near Fifteenth street and is one of the largest plants of the kind on the coast. It has a monthly production of 1,400,000 bottles, which will be increased within a short time. New officers of the company include: W. W. Watt, president; Moye W. Stevens, vice-president; Ben S. Hunter, secretary and H. P. Dickinson, general manager and director. All are Los Los Angeles men. Since assuming control of the company, the new officers have outlined an expansion program which will increase the plant's output, chiefly by concentrating their sales efforts on the Latin American countries and Asia, besides taking in more territory in the western part of America. For its export trade, the plant is particularly well situated, being near the Long Beach harbor, which it is claimed is rapidly becoming a port of call for ocean-going freighters as well as coastwise transportation. Besides this, it is within ten miles of Los Angeles harbor, and it is also well located for rail shipping.

Personal Items

Thomas McConnell, formerly connected with the Allegheny Plate Glass Company, Glassmere, Pa., was recently appointed purchasing agent for the Standard Plate Glass Corporation, Pittsburgh, Pa.

J. C. Keaney, formerly of the Macbeth-Evans Glass Company, Pittsburgh, Pa., and lately connected with the Inland Glass Company, Chicago, Ill., has become associated with the Libbey Glass Manufacturing Company, Toledo, O., in the sales department.

H. G. Schurecht, who has been doing research work for several years at the Mellon Institute, Pittsburgh, Pa., has accepted a senior fellowship in the Terra Cotta Fellowship at the Bureau of Standards, Washington, D. C. This work is being done under the auspices of the National Terra Cotta Society.

Irving E. Adams, consultant on glass problems, has become connected with the Continental Flat Glass Company, Shreveport, La., in the capacity of consulting engineer and will make his headquarters in that city. He will continue to accept consulting engagements from other concerns and can be reached through his new address, Box 491, Shreveport, La.

George J. Whelan, for the past five years vice-president and general manager of the Kelley Island Lime & Transport Company, Cleveland, O., producers of hydrated and ground burnt lime for the glass trade, was recently elected president of the company succeeding George R. Johnson, whose resignation was accepted at the annual meeting several months ago.

John B. Scohy, president of the Scohy Sheet Glass Company, Sistersville, W. Va., has arrived in Belgium for the purpose of visiting plants in Europe operating Fourcault machines to familiarize himself with the latest improvements in and the operation of this machine, which has been adopted for his plant at Sistersville.

A. F. Greaves-Walker, the well known ceramist, who was vice-president of the American Ceramic Society in 1918 and chairman of the Pittsburgh Section in 1922-1923, and who has recently been production manager for Stevens, Inc., of which company he is vice-president and a director, will take charge of the Department of Ceramic Engineering at the North Carolina State College, Raleigh, N. C. This course in ceramics has just been established.

Prof. W. E. S. Turner, head of the Department of Glass Technology, University of Sheffield, England, and Mrs. Turner sailed for home from Montreal on the White Star S. S. *Canada* on Saturday, September 20. Prof. Turner arrived in Toronto from England early in the summer where he attended the meetings of the British Society for the Advancement of Science. Since then he has been traveling through a large section of the United States, spending much of his time visiting glass factories.

Inquiries Received

For Further Information Address THE GLASS INDUSTRY.

222. Can you furnish me with the names of firms from whom I might obtain some glass prisms cut or molded to particular designs? (Sept. 4.)
223. We would like the name of the concern which manufactures the "Moonstone" globes. (Sept. 10.)
224. (From England) We would like the names of manufacturers of glass mixing bowls and other glass kitchen utensils. (Sept. 4.)
225. Can you furnish me with information as to the make of glass drills that give the best results when drilling holes up to ¾ inch? We are using a vertical motor driven drilling machine and hand drill. (Sept. 4.)
226. We are desirous of obtaining some semi-quartz cylinders and would appreciate it if you will advise what concern manufactures material of this type. (Sept. 23).

What the World Wants

Specific inquiries for American goods received in the Department of Commerce.

Numbers prefixed to the items refer to confidential information which may be obtained by concerns listed in the Exporters' Index by applying to the nearest district office of the Bureau of Foreign and Domestic Commerce, or to headquarters at Washington, D. C. Mention the number of the inquiry in which you are interested.

To become listed on the Exporters' Index, it is necessary to fill out a form (Form 57), which may be had upon application to the Bureau or its district or co-operative offices.

Netherlands. 11516. Soda ash.
Ireland. 11556. Milk containers, glass lined, for farms.
India. 11610. Glassware; 11670, soda ash.
Brazil. 11675. Soda ash.
Canada. 11745. Glass fruit jars.
Germany. 11757. Borax; *11732, glaziers' emery wheels.

Stock Quotations.

(Reported by Moore, Leonard & Lynch, Union Trust Bldg., Pittsburgh, Pa.)

PITTSBURGH STOCK EXCHANGE, SEPTEMBER 24, 1924

	Bid	Ask	Last
American Window Glass Machine, common	88	89	89
American Window Glass Machine, preferred	92	..	94
American Window Glass, preferred	..	110	109
Pittsburgh Plate Glass	..	253	250
U. S. Glass	18	22	18
Standard Plate Glass, common	22	23	22⅝
Standard Plate Glass, preferred			
Cumulative	85	88	87
Prior	98	..	99½

Glass stocks on the Pittsburgh Stock Exchange were in good demand with relatively few offers in the past month. Building glass demand shows little change. The automobile industry uses more than one half of the plate glass in the country and the curtailment of the automobile output over the past several months has materially affected the demand for plate glass. On the basis of present operations September automobile output is expected to exceed August by 10%. Fall prospect is for volume exceeding that for the corresponding period of any preceding year, except 1923. This anticipated revival should stimulate plate glass. Container manufacturers are getting ready for the usual Fall increase prior to the holiday season. Orders are moderate but steadily increasing, and a number of factories will resume operations this month. Market conditions are fair and the tone better than it was four to six weeks ago.

Standard Plate Glass Company, one of the largest plate glass producers in the United States with an annual production of 8,000,000 square feet was the feature of the market. Reduction of 15% on the price of their commodity, with the rumor of dissension in the management which was denied by the president, caused a decline in the shares of the company of 10 points from last month's high.

WHEELING STOCK EXCHANGE, SEPTEMBER 24, 1924

	Bid	Ask	Last
Hazel-Atlas	29½	30½	30
Imperial	75	90	90
Fostoria	140	..	150
Central	108	110	108

Hazel-Atlas stock was active and strong during the past month at a range of 27½ to 30½ closing near the high. Their new artificial gas producer is proving very satisfactory. Improvement in the demand for Wheeling glass products is expected in the near future.

TOLEDO STOCK EXCHANGE, SEPTEMBER 24, 1924

	Bid	Ask	Last
Owens Bottle Machine, common	42⅜	42⅝	42½
Libbey-Owens Sheet Glass, common	104	107	105
Libbey-Owens Sheet Glass, preferred	109	111	110

Current Prices of Glass-Making Materials

Quotations furnished by various producers, manufacturers and dealers

September 24, 1924

	Carlots	Less Carlots
Aluminum hydrate ($Al(OH)_3$)...lb.	.05	.05½
Aluminum oxide (Al_2O_3).....lb.	.06½	.07
Antimony oxide (Sb_2O_3).....lb.	.09½	.09¾
Arsenic trioxide (As_2O_3) (dense white), 99%.....lb.	.07	.07½
Barium carbonate ($BaCO_3$) (precipitated).....ton	63.00	65.00
Barium hydrate ($Ba(OH)_2$).....lb.	.05	.05½
Bone ash.....lb.	.06½	.07½
Borax ($Na_2B_4O_7 10H_2O$).....lb.	.04¾	.05½
Borax, fused ($Na_2B_4O_7$) any mesh.lb.	.19	.20
Boric acid (B_2O_3), fused.....lb.	.35	.35
Cadmium Sulphide (CdS)—		
Red.....lb.	..	1.60
Orange.....lb.	1.50	1.65
Yellow.....lb.	..	1.80
Chrome Oxide (Cr_2O_3).....lb.	.35	.38
Cobalt Oxide (Co_3O_4)—		
In bbls.....lb.	..	2.10
In 10 lb. tins.....lb.	..	2.20
Copper oxide—		
Red (Cu_2O).....lb.	..	.19
Black (CuO).....lb.	..	.25
Black prepared.....lb.	..	.30
Cryolite (Na_3AlF_6).....lb.	..	.09⅛
Feldspar—		
100 mesh.....ton	12.00-14.00	16.00-25.00
80 mesh.....ton	12.00	..
40 mesh.....ton	12.00	..
Ferrous oxide (FeO).....lb.	..	..
Fluorspar (CaF_2)—		
Powdered white, 95%.....ton	38.00	..
Hydrofluoric acid (HF) 60% (in lead carboys).....lb.	..	.13
Kaolin (f.o.b. mine).....ton	9.00	12.00
Lead Oxide (Pb_3O_4) (red lead)...lb.	.11	.11
Litharge (PbO).....lb.	.10½	.10½
Lime—		
Hydrated ($Ca(OH)_2$) (in 50 lb. paper sacks).....ton	12.50	..
Burnt (CaO) ground, in bulk.ton	9.00	..
Burnt, ground, in paper sacks.ton	11.00	..
Burnt, ground, in 280 lb. bbls. per bbl......	2.15	2.30
Magnesium carbonate ($MgCO_3$)...lb.	..	.08
Manganese 85% (MnO_2).....lb.	.03¼	.03¾
Nickel oxide (Ni_2O_3), black, for nickel content.....lb.	.32	.45
Nickel monoxide (NiO), green, for nickel content.....lb.	.30	.50
Potassium carbonate—		
Calcined (K_2CO_3) 96%.....lb.	.05½	.05¾
Hydrated (KOH) 85%.....lb.	.05¼	.06¼
Potassium nitrate (KNO_3) (gran.).lb.	.05⅞-.06	.06⅛-.06¼
Potassium Permanganate ($KMnO_4$).....lb.	.13	.14
Powdered blue.....lb.	..	.24-.26
Standard formula.....lb.	..	.32
Salt cake, glassmakers (Na_2SO_4), f.o.b. works.....ton	20.00-25.00	22.00-27.00
Selenium (Se).....lb.	..	2.10-2.25
Soda ash (Na_2CO_3) dense, 58%— f. o. b. works.		
Bulk, spot.....Flat 100 lb.	1.35-1.40	..
Bulk, on contract....Flat 100 lb.	1.35	..
In 400 lb. bbls., on contract.100 lb.	1.69	2.40
In 400 lb. bags, on contract.100 lb.	1.45	2.16
Spot orders .05 per 100 lbs. higher.		
Sodium nitrate ($NaNO_3$), refined (Gran.) in bbls.....lb.	.04⅛-.04¼	.04¼-.04½
Sodium selenite (Na_2SeO_3).....lb.	..	2.00
Sodium Fluosilicate (Na_2SiF_6)....lb.	..	.07½
Sulphur (S)—		
Flowers, 155 lb. bbl. Per 100 lb.	3.35	3.65-3.90
Flowers, in bags.....Per 100 lb.	3.00	3.30-3.55
Flour, heavy, in bbls..Per 100 lb.	2.50	2.80-3.05
Uranium oxide (UO_3), 100 lb lots.lb.	..	1.25
Zinc oxide (ZnO).....lb.	.08	.08¼

Monthly Summary of United States Foreign Commerce in Glass

EXPORTS

Corrected to August 23, 1924

Glass and glass products (total)	July 1923 Quantity	July 1923 Value	July 1924 Quantity	July 1924 Value	Seven Months Ending July 1923 Quantity	Seven Months Ending July 1923 Value	Seven Months Ending July 1924 Quantity	Seven Months Ending July 1924 Value
	.....	944,527	.....	767,099	.....	6,510,426	.....	5,212,079
Plate and window glass—								
Window glass, common, box 50 sq. ft.	4,125	21,767	3,344	18,089	28,522	154,688	24,844	110,764
Plate glass, unsilvered, sq. ft.	190,013	68,763	193,031	58,051	1,457,548	590,967	1,215,050	350,919
Other windows and plate glass, n.e.s.lbs.	88,294	24,070	144,028	12,780	2,277,375	259,886	1,170,058	127,385
Glass containers (bottles, vials and jars).lbs.	6,914,965	323,628	6,686,753	265,499	44,111,398	2,108,570	34,959,029	1,698,819
Table glassware, plain.lbs.	1,656,539	205,621	1,616,271	179,293	11,724,682	1,286,718	9,314,163	10,378,836
Table and other glassware, cut or engraved.lbs.	52,361	17,640	89,205	17,429	333,030	128,288	285,734	85,648
Glass for lighting—								
Lamp chimneys and lantern globes.lbs.	163,316	32,165	226,592	37,389	1,177,012	233,226	1,195,185	222,346
Globes and shades for lighting fixtures.lbs.	129,397	44,498	92,664	25,416	823,304	257,431	740,553	226,952
Lamps and other illuminating devices, chiefly of glass.lbs.	138,954	25,041	78,040	13,990	935,343	232,435	640,844	181,618
Chemical glassware.lbs.	22,075	13,625	20,045	17,707	123,268	90,815	120,941	100,807
Electrical glassware, except for lighting.lbs.	311,990	17,643	170,981	20,889	1,709,647	112,936	1,697,405	160,271
Other glassware, n.e.s.lbs.	943,722	150,066	608,026	110,567	6,166,793	1,054,466	5,759,642	908,714

IMPORTS

Corrected to August 23, 1924

Glass (total)	.....	2,394,438	.....	1,735,808	.....	13,140,503	.....	12,089,555
Cylinder, crown and sheet lbs.—								
Unpolished, lbs.dut.	3,537,927	182,336	3,691,296	211,193	29,647,319	1,318,840	19,466,940	1,140,674
Bent, ground, leveled, colored, painted, etc., and polished.dut.	.....	106,848	.....	37,636	.....	484,062	.....	313,484
Plate glass—								
Unsilvered, sq. ft.dut.	2,569,609	1,606,826	1,372,655	790,583	14,006,851	8,115,476	11,353,013	7,116,613
Fluted, rolled, etc., or silvered, or containing wire netting, sq. ft.dut.	202,608	35,912	343,707	30,766	1,251,625	227,759	1,864,605	230,868
Containers—bottles, vials, etc.dut.	.....	4,047	.....	11,420	.....	138,003	.....	137,149
Table and kitchen utensils, lbs.dut.	14,884	8,580	19,809	4,098	210,670	71,436	503,902	104,184
Glassware, cut or decorated, lbs.dut.	368,402	132,515	355,097	176,060	1,789,659	694,109	1,941,875	932,790
Blown glassware, n. e. s., lbs.dut.	548,173	111,501	.....	.....	3,397,456	689,574	.....	.....
Bottles, ornaments, etc., lbs.dut.	.....	.....	752,779	216,209	.....	.....	2,586,799	834,748
Bulbs or electric lamps, number.dut.	.....	.....	1,656,470	39,565	.....	.....	7,715,780	134,860
Chimneys, globes, shades, etc., lbs.dut.	.....	.....	417,887	86,284	.....	.....	2,693,072	456,493
Articles and utensils for chemical, scientific, and experimental purposes, lbs.dut.	.....	.....	85,714	30,546	.....	.....	558,899	188,055
Other glassware.....{ free	.....	205,873	.....	101,448	.....	1,401,244	.....	499,637
{ dut.	.....	1,899,318	.....	2,036,389	.....	11,213,987	.....	12,753,840